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SIR WILLIAM JONES



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A NOTE ON THE BHĀSKAREŚVARA-LIṄGA

By DEBALA MITRA

The temple known as Bhāskareśvara at Bhubaneswar, Orissa, has attracted the attention of scholars before by its very distinctive shape and design and the high stump-shaped *liṅga* with a broken top that it enshrines. The *bāḍa* of the temple is built in two tiers; the upper, approachable by a flight of steps against the northern wall of the lower (which looks like a platform from a distance), is pierced with a door on the western side. The unconventional construction was no doubt due to the necessity of giving access to the worshipper to reach the top of the *liṅga* for *abhisheka*, etc.

It has all along been suspected that the *liṅga* is the remnant of a pillar. It was even suggested by Rajendra Lala Mitra that the pillar was one of Aśoka made into a *liṅga* by the Hindus after it had lost its upper part and that the temple was erected over it to give shelter to it.¹ Manomohan Ganguly, however, found it 'very difficult to accept this view unless some other cogent reasons are advanced in its favour except that the place was a stronghold of Buddhism'.²

The question of the Aśokan origin of the pillar has been examined in more recent years by N. K. Basu,³ who ruled out 'the possibility of an Aśokan origin, as all of the Emperor's pillars are known to bear a characteristically fine polish'. He, however, thought it 'not unlikely that a pillar was erected here by some king after Aśoka's fashion and a railing was also set up all around, the remains of which now lie scattered and buried in the soil at some distance from the mound'.⁴ He also drew attention to the existence of a bell-shaped capital lying at a corner of a large tank called Aśokā-Kuṇḍa (also called Aśoka-Jharā) at Bhubaneswar. On the hypothesis that the Aśokā-Kuṇḍa capital had originally belonged to the pillar in the Bhāskareśvara, he felt that a portion of the pillar 'anywhere from 29' to 33'' should be embedded in the mound. At the same time, he did not discount the possibility of the pillar and capital being unconnected with each other, as is indeed suggested by the difference of the stone used in them. He also suggested two lines of research, namely, to search the jungles of Bhubaneswar for a column suitable to hold such a capital as large as the Aśokā-Kuṇḍa one and to expose the Bhāskareśvara pillar to its root, 'in order to determine its actual length and see if it bore any inscription or not'.

Of late the question has been examined afresh by K. C. Panigrahi⁵ who felt that the original smooth surface of the pillar, presumably bearing an inscription, had been deliberately chiselled off, leaving a rough surface that the pillar now has. He even says: 'These peculiarities of unusual character led to further scrutiny which revealed the traces of some Aśokan Brāhmī letters on a vertical portion of the *liṅgam* where chiselling seems to have been less heavy.'⁶ The discovery of stone railings not far off led him to the conclusion that a railed *stūpa*, the usual accompaniment of an Aśokan pillar, stood nearby—a conclusion strengthened, according to him,

¹ R. Mitra, *Antiquities of Orissa*, II (Calcutta, 1880), p. 89.

² *Orissa and her Remains—Ancient and Mediaeval* (Calcutta, 1912), p. 324.

³ *Journal of the Bihar and Orissa Research Society*, XV (1929), p. 259ff.

⁴ *Op. cit.*, p. 260.

⁵ *Journal of the Asiatic Society*, XVII (1951), p. 98ff.

⁶ *Op. cit.*, p. 98.

by the discovery of a lion-capital, of the same colour and fabric as the pillar, near the temple. He had also no doubt that the bell-capital mentioned above belonged to the same group.

In view of the interest attached to the problem and of my failure to notice any traces of Brāhmī letters on the *liṅga*, I exposed its underground features—one of the measures for the solution of the problem recommended by N. K. Basu. The results of my excavation are given below.

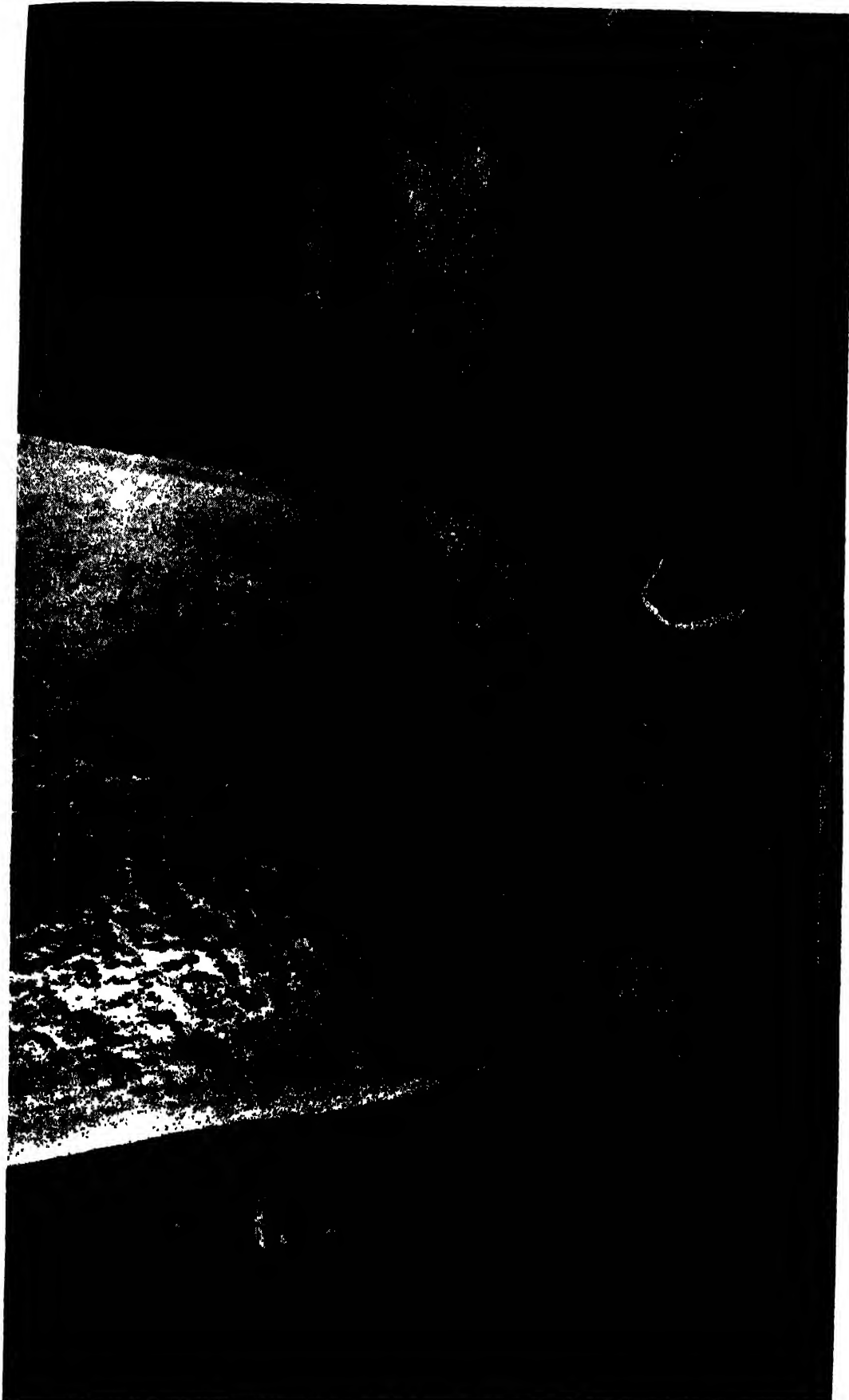
The eastern halves of the floor of the temple, consisting of one course of sandstone blocks and of the sandstone *arghya-paṭṭa* encircling the pillar were removed, whereon it was noticed that a laterite-bed, rising high above the surrounding surface, had been cut into a roughly rectangular shape. The centre of the platform thus formed was fashioned into a round pedestal, 6 ft. in diameter, having a rectangular projection in the shape of an *arghya-paṭṭa* (Pl. I).¹ The pedestal was made in two planes, the inner one, with a diameter of 3 ft. 11 in., being higher than the outer by 1 in. to 3 in. The diameter of the inner circle was almost the same as that of the pillar that was to rest on it. On the margin, of the average width of 1 ft. $\frac{1}{2}$ in., thus left on the top of the outer circle, together with its projecting part, was placed a sandstone *arghya-paṭṭa* in four pieces, slightly more than 1 ft. high, which completely covered the laterite-cut *arghya-paṭṭa* and encircled the pillar up to the height of about 10 in.

The lowest 4 in. to 4 $\frac{1}{2}$ in. of the pillar were found to be roughly polished, contrasting the highly-pitted surface of the rest of the pillar. At the top of the polished portion were noticed two incised arrow-marks at a distance of 8 ft. 2 in. from each other (i.e. almost a quarter of the circumference of the pillar), the one facing the eastern opening being pointed upwards and the other facing the southern opening downwards. It may be surmised that similar marks exist on the unexposed northern and western faces as well and were intended to guide the fixing of the pillar in the desired position. Whether the bottom of its centre contained any tenon to go into a mortise in the laterite pedestal could not be ascertained as that would have involved a serious disturbance to the pillar. It should be noted that the unpolished part of the pillar just above the polished one slightly projects over the latter at places, so that it is evident that the pitting of the surface cannot be due to the chiselling of a polished surface that might have originally existed all over the pillar. The process was indeed the reverse: the polishing of the lowest part was attended to following a rough dressing. However, the purpose of polishing only this part which was intended to remain hidden was not clear.

The space between the edges of the laterite bed and the wall-bases was filled with thick slabs of stones capped by the floor mentioned above.

From the foregoing observations, it is abundantly clear that the pillar has no foundation at all and directly rests on the laterite pedestal deliberately carved in the shape of an *arghya-paṭṭa*. This can only mean that whoever installed the pillar in its present position conceived it as a *liṅga* from the beginning. In other words, the temple was not erected to enshrine an already standing pillar or *liṅga*. Further the pillar, with a broken top, was evidently brought from elsewhere, near or far. The present operation did not give any clue to the origin of the pillar, not to speak of the place of its initial installation.

¹ The photograph reproduced here is the copyright of the Department of Archaeology, Government of India.



Lowest part of the Bhāskareśvara-*liṅga*, Bhubaneswar

NEW DATA ON THE RADIO WAVES FROM SUNSPOTS

By D. KOROLKOV and N. SOBOLEVA

One of the interesting objects observed on the Sun are the sunspots. These spots are the chief indicators of solar activity. A study of sunspots is interesting because the changes in solar activity affect certain terrestrial phenomena, for instance, radio-wave propagation, the Earth's magnetic field, atmosphere, etc. Solar activity reaches a maximum once in 11.5 years on the average.

Our information concerning the spots and the processes occurring in them is rather limited. We know that the temperature of the spots is approximately 5,000°C., i.e. one thousand degrees lower than that of the visible surface of the Sun, or photosphere, that is why they seem dark. The spots are known to appear almost exclusively within the zone bounded by $\pm 35^\circ$ of latitude from the solar equator. The lifetime of the spots ranges from several days to several months. Their total area in years of sunspot maximum amounts to several per cent of the surface of the Sun. In the minimum years, spots almost completely disappear. They possess a strong magnetic field of the order of 4,000 to 5,000 gauss. Since magnetic fields play a very important part in solar processes, the magnetic field evidently is the most important characteristic of the spots. For the greater part sunspots occur in bipolar groups consisting of two spots of different magnetic polarity, the leader spot (in the direction of the Sun's rotation) is usually larger and possesses a stronger field.

In the course of the eleven-year cycle, the polarity of the leader is definite and opposite to the polarity of the leader in the other hemisphere. During the next cycle the polarity of the spots is reversed. A study of magnetic phenomena in the spots and the specific features of physical processes connected with them is of great interest and indispensable for an understanding of the nature of the spots.

The measurement of the fields in the spots is accomplished by the optical method—by observing the Zeeman effect (the splitting of spectral lines in the magnetic field). This method makes it possible to determine the field intensity only on the photosphere because the weak radiation of the solar atmosphere (the chromosphere and the corona above it) optically too thin for visible light cannot be made out on the bright background of the photosphere.

Radio observations can supplement the data obtained by optical methods. The solar atmosphere is a highly ionized gas. The transparency of this gas varies for different wavelengths and depends upon the concentration of electrons (or ions). Thus, for metre wavelengths the upper regions of the corona where electron density is about 10^7 cm.^{-3} are opaque. The radiation of metre waves coming from the deeper layers is absorbed in the corona and cannot be seen. Thus, the corona may be considered "black" for metre wavelengths; hence like all black bodies, according to Kirchhoff's law, it must radiate in this wavelength range in accordance with its kinetic temperature.

For centimetre wavelengths the corona is absolutely transparent and the layers in which the radiation of this wavelength is absorbed (from which we correspondingly receive the radiation) lie considerably deeper—in places

where electron concentration reaches $10^9 - 10^{10} \text{ cm.}^{-3}$. This corresponds to the upper layers of the chromosphere.

Observations of radiation at different wavelengths make it possible to sound solar atmosphere and to get information from different altitudes. A study of the radio waves coming from the areas covered by the spots will give us an idea about the physical conditions in the atmosphere of the Sun above the spots, where owing to the presence of a strong magnetic field certain specific features may be observed.

It is known that ionized gas crossed by a magnetic field becomes a birefringent medium, i.e. a medium in which propagation constants (the coefficient of absorption and the refractive index) are different for the waves of dextro- and levorotation (the so-called ordinary and extraordinary waves).

This leads to the splitting of the radiation levels for the ordinary and extraordinary waves in the solar atmosphere above the spots, i.e. the radiation of these waves proceeds from different effective altitudes and since the temperature at different altitudes is different this splitting must lead to the circular polarization of radiation. Thus, the polarization of radiation measured at different wavelengths may serve as an index of the magnetic field for different effective altitudes of the solar atmosphere (to be more exact, may serve as an index correlating the field intensity, electron density and temperature).

The polarization of radio waves from the spots was up till recently observed chiefly at decimetre and metre wavelengths for which the corona is responsible (at an altitude of over 50,000 km. above the photosphere).

In 1956, observations were begun in the Main Astronomical Observatory in Pulkovo of the polarization of the sunspot radiation at a wavelength of 3 cm. Radiation of these wavelengths comes from the upper layers of the chromosphere—about 10,000 km. above the photosphere.

The apparatuses for these observations were constructed in the Physics Institute of the Academy of Sciences. The work of the apparatuses is based on the application of a polarization modulator which makes it possible to exclude the non-polarized background of the source's radiation (see Fig. 1). The energy collected by the mirror of the radio telescope (1) enters the circular waveguide (2) in which waves of all planes of polarization can spread.

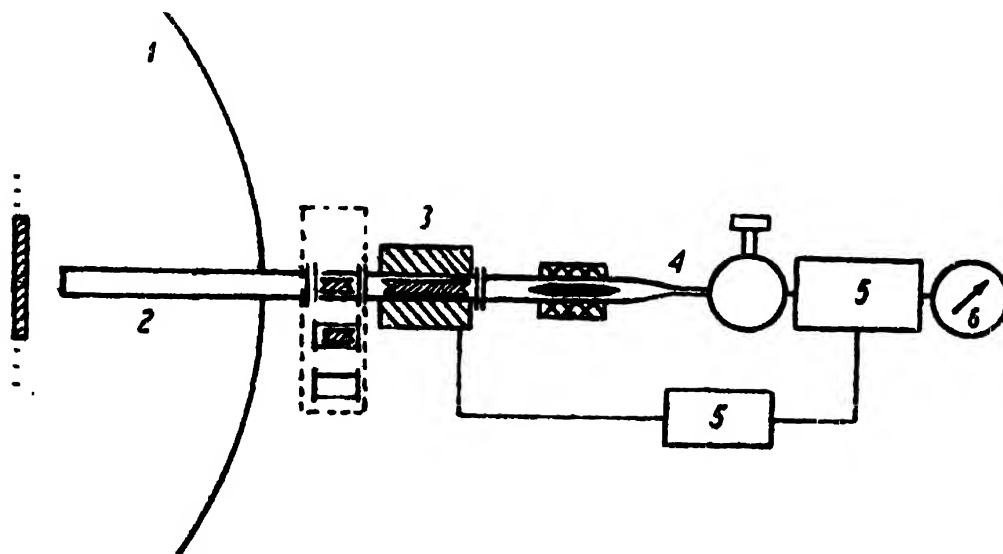


FIG. 1. Diagram of a polarization radiometer. 1. Radio telescope mirror. 2. Circular waveguide. 3. Dielectric plate. 4. Rectangular waveguide. 5. Receiver. 6. Output meter.

A dielectric plate (3) is inserted in the circular waveguide (2) which causes a half-wave delay of the oscillation of those waves, the electric vector of which lies in the plane of the plate. If this plate, which serves as the modulator, is made to rotate the plane of polarization of the wave propagated in the waveguide will also rotate. Behind the modulator the circular waveguide is transformed into the rectangular guide (4) in which only waves of a definite polarization can spread. The rectangular waveguide acts as an analyser. When the polarization plane of the linear polarized signal rotates before the analyser the energy in the rectangular waveguide is modulated. The modulated signal is sent to the input of the receiver (5), is amplified and registered by the output metre. Obviously, the unpolarized radiation (natural light) is not modulated and does not hinder the isolation of the polarized component.

In order to isolate circular polarization a plate which delays oscillations by one-fourth of a wave and transforms signals from circular to linear polarization is introduced into the aerial line by means of a special block of changeable sections. This signal is then modulated. A radio telescope with a reflector diameter of 4 metres was used for the observations. The data obtained after several months of observations have made possible the following principal conclusions.

Circular polarized radiation is emitted from the regions of the Sun lying above the large spots. It is very stable and arises with the same sign of rotation when the spots appear again (after one rotation of the Sun).

For some of the spots, the magnitude of the polarized component of radiation amounted to 5 per cent of the radiation of the whole Sun.

The sign of polarization was found to be related to the polarity of the magnetic field in the photosphere. Dextrorotation corresponds to the north magnetic pole and levorotation to the south pole.

At the same time observations of linear polarization were conducted. Its magnitude did not exceed 0.5 per cent and no correlation with any visible changes on the Sun could be established.

In order to determine the size of the radiating area, observations of polarization were undertaken in Pulkovo during the partial solar eclipse on December 2, 1956.

Fig. 2 shows the course of the eclipse which was observed beginning with the maximum phase since it started under the horizon. Curve 1 shows the change in the circular polarization signal; curve 2 the phase of the eclipse; curve 3 the path of the centre of the Moon. A sharp leap was observed in the intensity of the polarization signal which began at 10-59 a.m. local time.

Fig. 3 shows a section of the record of the eclipse including the leap. Here is shown a group of spots in the corresponding scale and the successive positions of the edges of the lunar disc. One can see that the source of polarized radiation opened in about three minutes and the maximum growth of the signal occurred in the course of 1.5 minutes corresponding to the opening of one of the nuclei of the tailer spot.

Taking into consideration the rate of motion of the Moon as compared with the Sun the angular size of the radiating area can be determined—it amounts to less than 0.5 angular minutes. Knowing the size of the region and the radiated input the effective temperature of the polarized radiation can be determined. It is of the order of 400,000°C.

According to contemporary views, the chromosphere consists of separate fibres, the hottest of which may be 150,000°C.

The observed high temperature of polarized radiation cannot be due to any of the known types of chromospheric fibres. In order to explain

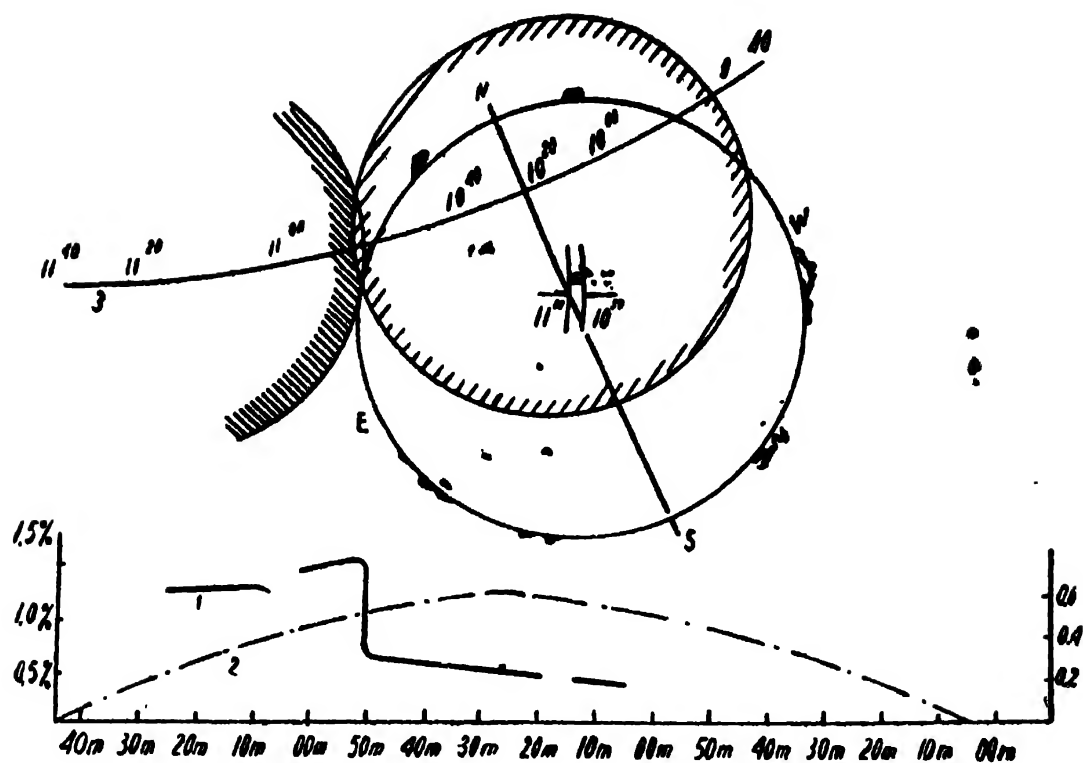


FIG. 2. Progress of the partial eclipse of December 2, 1956, as observed in Pulkovo.
1. Circular polarization. 2. Phase of eclipse.

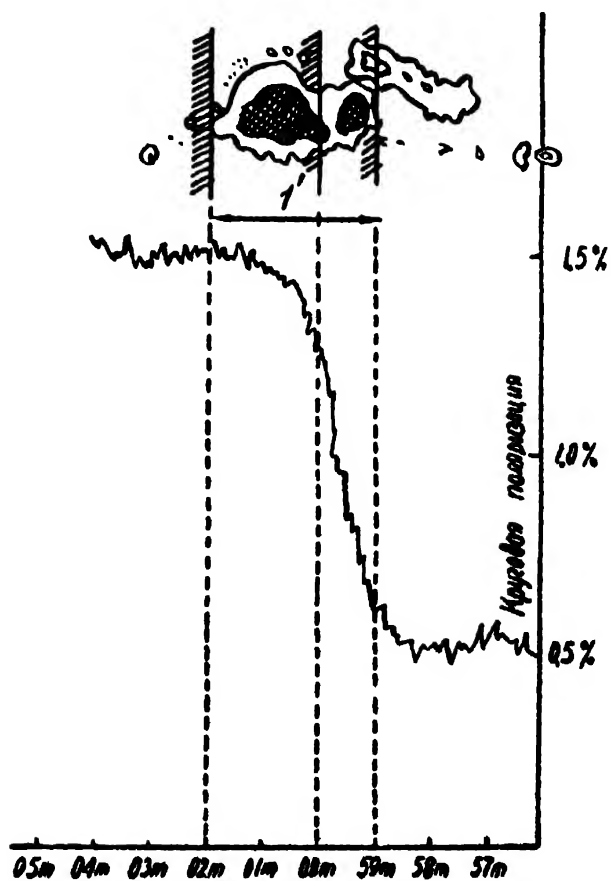


FIG. 3. A section of the curve of radio-wave emission polarization recorded during the solar eclipse. 1. Circular polarization.

the observed effect (taking the radiation to be of the heat type) we must allow that there exist in the regions responsible for the radiation compact areas with temperatures of about $5 \cdot 10^6$ degrees centigrade and a strong magnetic field. These may be the coronal condensations sometimes observed in the area of the spots.

Observations conducted during the International Geophysical Year, a study of the polarization at other centimetre wavelengths and a comparison of the results with the data of optic observations will help throw light on the correlation between the polarization of radiation, magnetic field intensity and other indices of the medium.

THE ENDOSKELETON OF *WALLAGÓ ATTU* (BL. AND SCHN.),

PART I—THE SKULL

By B. M. SINHA

(Communicated by Dr. G. P. Majumdar)

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INTRODUCTION

In view of the need of a description of a bony fish, the common catfish *Wallago attu* has been selected for study. It is easily procurable, is of convenient size for dissection and it is represented throughout India by a single species.

In this paper a reasonably complete account of the skull of the fish is being given and the next paper will be devoted to the rest of the skeleton. It is hoped that a memoir on the type will be made available before long.

I take this opportunity of offering my thanks to Professor M. L. Bhatia for guiding the work. My thanks are due to the authorities of Meerut College for providing me facilities for the work.

I. THE SKULL

The skull is well formed and composed of both replacing and investing bones. It may be distinguished into the cranium and the visceral skeleton.

A. THE CRANIUM

The cranium (I, II and III) is a compact structure with the two sense capsules fused with it. It is wedge-shaped with the narrow end directed forward. On its dorsal side are two median fontanelle, one behind the other, the anterior of which is more prominent than the posterior.

The cranium may be distinguished from behind forwards into the occipital, auditory, sphenoidal, orbital and ethmoidal regions.

(i) *The Occipital Region*

The occipital region consists of four replacing bones, the supraoccipital on the roof, two exoccipitals on the sides and basioccipital in the floor.

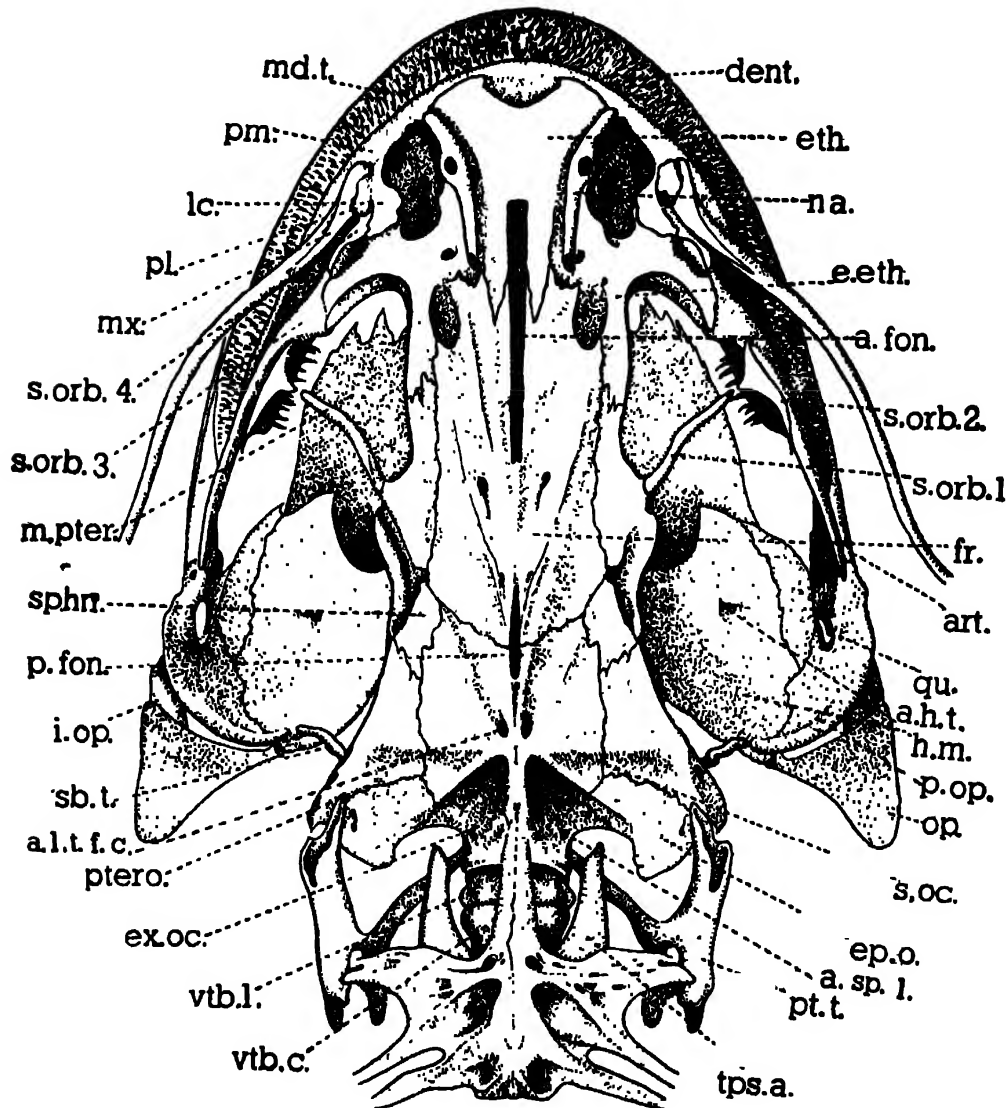


FIG. I.

Dorsal view of the skull ($\times 5/6$).

ang., angular; *a.fon.*, anterior fontanelle; *a.h.t.*, aperture hyomandibular trunk of facial nerve; *a.l.t.f.c.*, aperture lateralis trigeminofacial complex; *a.sp. 1.*, aperture of first spinal nerve; *dent.*, dentary; *ep.o.*, epiotic; *eth.*, ethmoid; *ex.oc.*, exoccipital; *fr.*, frontal; *h.m.*, hyomandibula; *i.op.*, interoperculum; *lc.*, lacrymal; *l.eth.*, lateral ethmoid; *md.t.*, mandibular teeth; *m.pter.*, metapterygoid; *na.*, nasal; *op.*, operculum; *p.fon.*, posterior fontanelle; *pl.*, palatine; *p.m.*, premaxilla; *p.op.*, preoperculum; *ptero.*, pterotic; *pt.t.*, posttemporal; *s.orb. 1-4*, first, second, third and fourth suborbitals; *qu.*, quadrate; *soc.*, supraoccipital; *sphn.*, sphenotic; *tps.a.*, tripus anterior part; *vtb. 1.*, first vertebra; *vtb.c.*, complex vertebra.

The *supraoccipital* (I, III and IV-1) is a flat bone, which slopes from its middle both forwards and backwards. A median longitudinal cleft at its front end forms the back half of the posterior fontanelle. From

behind the cleft extends backwards a laterally compressed *occipital crest*, which meets the forwardly directed neural spine of the complex vertebra. From either side radiate two ridges, one directed forwards and the other backwards. The four ridges form a cross-like pattern and indicate the position of the underlying semicircular canals of the internal ear. In the angle between each forwardly directed ridge and the occipital crest is a foramen, through which emerges the lateralis branch of the trigeminofacial complex of its side. The supraoccipital articulates with the frontal and sphenotic in front and with pterotic, epiotic and exoccipital on either side.

The *exoccipitals* (I, II, III and IV-2) are small irregular bones. From the dorsal side of each arises a thin laterally compressed neural plate, which meets the supraoccipital. The *neural plate* gives off a horizontal plate towards the inner side and an inclined plate towards the outer side. The *horizontal plate* runs in and meets a similar plate from the other exoccipital to form a platform on which rests the medulla oblongata. The *inclined plate* leans backwards and joins the supraoccipital and epiotic. A perforation on the ventral side of the bone is for the glossopharyngeal nerve and a large foramen behind is for the vagus nerve. A little dorsal to the opening of the vagus nerve is a small aperture for the first spinal nerve. The exoccipital is attached in front to the supraoccipital and prootic, on the outer side to the pterotic and epiotic and on the inner side to the basioccipital.

The *basioccipital* (II and IV-3) is more or less flat along its upper surface, while its lower surface is produced into a ridge. At its posterior end is the *occipital condyle* in the form of a concave facet. Below the condyle are two backwardly directed processes, which abut against similar processes from the first vertebra. In front of the processes, around the ventral and lateral sides of the bone is a semicircular ridge and behind this ridge on either side is a depression for insertion of the inferior limb of the posttemporal of its side. The lower side of the bone, in front of the ridge, is corrugated. On its upper surface, immediately in front of the condyle, arise a pair of vertical ridges, which meet the horizontal plates of the exoccipitals and enclose between them a vacuity—the *cavum sinus imparis*. The basioccipital unites in front with the parasphenoid and on either side with the exoccipital and prootic.

(ii) The Auditory Region

Each auditory region, which lies on the postero-lateral side of the cranium, is ossified and is made up of four bones—the prootic, epiotic, sphenotic and pterotic. The opisthotic is absent in *Wallago*. All the bones of this region are replacing bones.

The *prootic* (II and IV-4) is a flat squarish bone on the ventral side of the auditory region. It is produced behind into a short backwardly directed process. From about the middle of the upper surface of the bone arises a plate-like process which marks the anterior limit of the recess of the membranous labyrinth. The prootic articulates with the parasphenoid and pleuro-sphenoid in front, with the sphenotic and pterotic on the outer side, with the exoccipital behind and with the parasphenoid on the inner side.

The *epiotic* (I, II and IV-5) is situated at the posterior end of the auditory region. It is more or less spatulate in form. A vacuity, which lodges a part of the posterior vertical canal of the internal ear, lies in its anterior region and divides it at this end into a dorsal and a ventral lamella. The posterior end terminates freely into a flattened semicircular head. By the dorsal lamella the epiotic unites with the exoccipital, supraoccipital and pterotic and by the ventral lamella with the exoccipital and pterotic.

The *pterotic*¹ (I, II and IV-6) is a large bone and lies along the outer boundary of the auditory region. It is produced behind into a *pterotic process*, which runs on the outer side of the epiotic and unites with it. Along the inner side of the bone is a deep groove in which lies a part of the horizontal canal of the internal ear. On its ventral side is another groove, which is

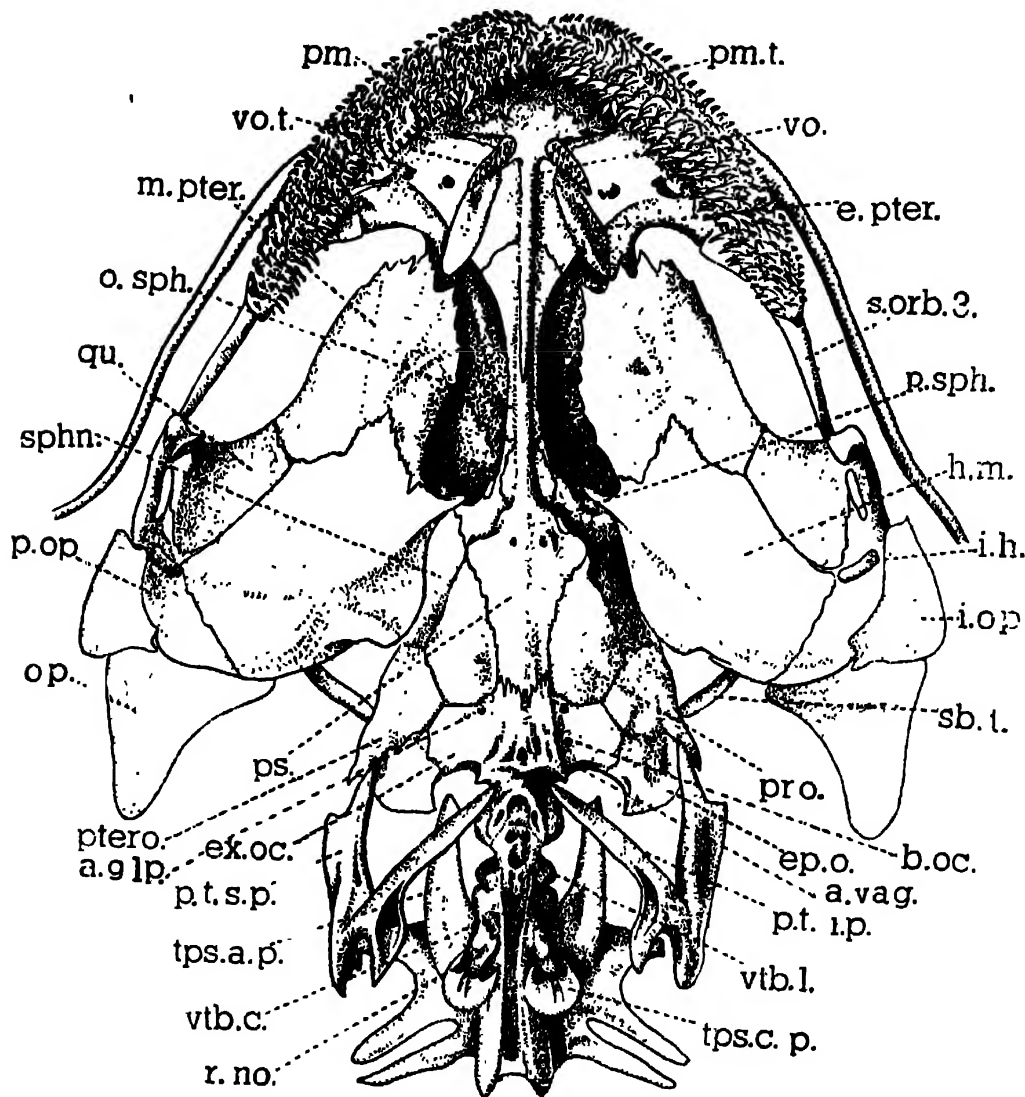


FIG. II.

Ventral view of the skull ($\times 5/8$).

a.glp., aperture glossopharyngeal nerve; *a.vag.*, aperture vagus nerve; *b.oc.*, basioccipital; *ep.o.*, epiotic; *e.pter.*, ectopterygoid; *ex.oc.*, exoccipital; *h.m.*, hyomandibula; *i.h.*, interhyal; *i.op.*, interoperculum; *m. pter.*, metapterygoid; *o.sph.*, orbitosphenoid; *op.*, operculum; *p.m.*, premaxilla; *pm.t.*, premaxillary teeth; *p.op.*, preoperculum; *pro.*, prootic; *p.sph.*, pleurosphenoid; *p.t.s.p.*, posttemporal superior process; *ps.*, parasphenoid; *qu.*, quadrate; *r.no.*, radial nodule; *s.orb. 3.*, third suborbital; *sphn.*, sphenotic; *tps.ap.*, tripus anterior part; *tps.c.p.*, tripus crescentic part; *vo.*, vomer; *vo.t.*, vomerine teeth; *vtb. 1.*, first vertebra; *vtb.c.*, complex vertebra.

shallow and which is a continuation of a more prominent groove on the sphenotic. The pterotic joins in front with the sphenotic, behind with the

¹ The pterotic, according to Bhimachar (1933-34), is formed of a chondral and a dermal element in Siluroids and as such it may be considered equal to the squamosal and pterotic and called squamosopteric. Srinivasachar (1958) found it to arise as a single ossification and called it merely pterotic.

epiotic and on the inner side above the groove with the supraoccipital and below it with the prootic and exoccipital.

The *sphenotic* (I, II and IV-7) marks the anterior boundary of the auditory region and the posterior limit of the orbit. It consists of a much thickened main part and a forwardly directed flattened process. The main part has a vacuity on the inner side which lodges the acoustic tubercle of the brain. On its ventral side is a longitudinally directed groove, which in continuation with the groove on the pterotic, gives articulation to the hyomandibular bone. On the upper surface of the bone is a longitudinal and a transverse groove, the former for the postorbital canal and the latter for the frontal commissure of the lateral line canal system. The sphenotic articulates behind with the pterotic and on the inner side above the upper margin of the vacuity with the supraoccipital and frontal and below the lower margin with the prootic and pleurosphenoid. Its process extends forward articulating with the frontal on the inner side and is connected in front with the lateral ethmoid.

(iii) The Sphenoidal Region

The sphenoidal region comprises of the frontals, pleurosphenoids, orbitosphenoid and basisphenoid. On the ventral side of the sphenoidal region is a large parasphenoid. The parietals are absent and the basisphenoid is reduced in *Wallago*. The pleurosphenoids, orbitosphenoid and basisphenoid are replacing bones, while the frontals and parasphenoid are investing ones.

The *frontals* (I and IV-8) are a pair of flat bones on the dorsal side of the frontal segment. They are large and extend behind to cover the dorsal side of the parietal segment with the extension of the supraoccipital. On the dorsal side of each frontal runs an oblique ridge, along the inner side of which lies the supraorbital canal of the lateral line system. Its inner margin drops sharply down to articulate with the pleurosphenoid and orbitosphenoid. In between the two frontals in front is a median cleft, which forms the posterior two-third of the anterior fontanelle. A similar but much less prominent cleft in between the frontals behind is the front half of the posterior fontanelle.

The *pleurosphenoids* (II and IV-9) are small irregular bones, one on either side of the sphenoidal region. Each with the sphenotic of its side marks the posterior boundary of the orbit. It is composed of a thickened body and a forwardly directed process. Bounded in front by pleurosphenoid and parasphenoid and behind by prootic is a wide fenestra for the common trunk of the fifth and seventh cranial nerves. The body of the pleurosphenoid articulates with the prootic behind, with the sphenotic on the outer side and with the parasphenoid on the inner side, while the process is suturally connected with the orbitosphenoid in front.

The *orbitosphenoid* (II and IV-10) is a median bone in the frontal segment of the cranium, formed by the fusion of the paired ossifications. The compound bone is dumb-bell-shaped, narrow in the middle and broad at the two ends, and it is hollow like a drain pipe. Its lateral rims run inwards and then upwards and finally fuse with the dropping margins of the frontals. The cavity of the bone is divided in front by a vertical ridge into two lateral channels for the passage of the olfactory tracts of the brain. The orbitosphenoid articulates in front with the lateral ethmoids and behind with the pleurosphenoids.

The *basisphenoid* (II and IV-11) is a small rhomboidal bone on the dorsal side of the parasphenoid. It lies partly over the body and partly

on the arm of the parasphenoid and is intimately connected with it. The upper surface of the bone is concave and forms the floor of the brain.

The *parasphenoid* (II and IV-11) is a long bone on the ventral side of the sphenoidal region. It consists of the rhomboidal body and a long forwardly directed arm. The body is elongated in an antero-posterior direction. Its upper surface is more or less flat, while the lower surface is produced into a median ridge. Bounded below by the parasphenoid and above by the pleurosphenoid is an oval aperture, one either side, for the optic nerve. The body of the parasphenoid articulates behind with the basioccipital after over-running its anterior half and on the sides with the

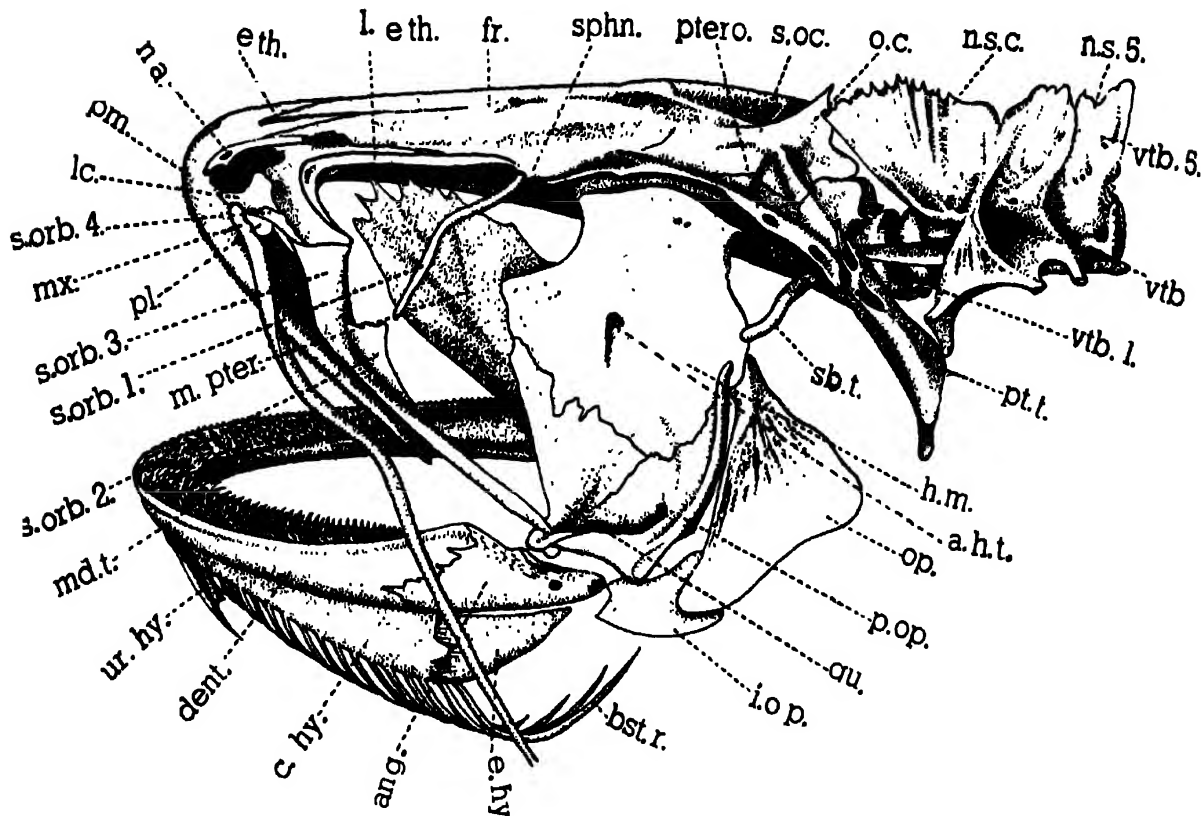


FIG. III.

Side view of the skull ($\times 5/6$).

ang., angular; *a.h.t.*, aperture of hyomandibular trunk; *bst.r.*, branchiostegal ray; *c.hy.*, ceratohyal; *dent.*, dentary; *eth.*, ethmoid; *e.hy.*, epihyal; *fr.*, frontal; *h.m.*, hyomandibula; *i.op.*, interoperculum; *lc.*, lacrymal; *l.eth.*, lateral ethmoid; *mx.*, maxilla; *md.t.*, mandibular teeth; *m.pter.*, metapterygoid; *na.*, nasal; *n.s.c.*, neural spine complex; *n.s. 5.*, neural spine fifth vertebra; *o.c.*, occipital crest; *op.*, operculum; *p.op.*, preoperculum; *ptero.*, pterotic; *pt.t.*, posttemporal; *p.m.*, premaxilla; *pl.*, palatine; *qu.*, quadrate; *s.orb. 1-4.*, first, second, third and fourth suborbitals; *s.oc.*, supraoccipital; *sphn.*, sphenotic; *ur.hy.*, urohyal; *vtb. 1.*, first vertebra; *vtb.c.*, complex vertebra; *vtb. 5.*, fifth vertebra.

prootics. The arm extends forward underneath the orbitosphenoid and is connected in front with the vomer.

(iv) The Orbital Region

The orbital region consists of the orbits and the orbital bones. The orbits are large. Each is bounded in front by the lateral ethmoid, on the inner side by the lateral ethmoid and sphenotic, and behind by the sphenotic. The orbital bones are the four suborbitals and the lacrymal, which lie embedded in the superficial muscles and extend in a chain below and in

front of the eye. The first two of these form the descending series and the other three the ascending series. The bones are investing ones and are for the passage of the infraorbital trunk of the lateral line system.

The *first suborbital* (I, III and IV-12) is a splint-like curved bone and it runs from the sphenotic to the posterior boundary of the eye. The *second suborbital* (I, III and IV-13) is a small triangular piece, which lies partly over the third suborbital on the posterior boundary of the eye. The *third suborbital* (I, III and IV-14) is a stout bone, long, curved and flattened at its two ends. It articulates with its prominent head with the lateral ethmoid and extends behind, beyond the second suborbital, to join the quadrate and angular at the angle of the mouth. It is tunnelled along its head only for the passage of the infraorbital trunk of the lateral line system. The *fourth suborbital* (I, III and IV-15) is small and lies in front of the third suborbital on the outer side of the olfactory capsule.

The *lacrymal* (I, III and V-5) is a small triangular bone, which lies anterior to the fourth suborbital bone over the base of the maxilla. The infraorbital trunk penetrates and terminates in the lacrymal.

(v) *The Ethmoidal Region*

The ethmoidal region is composed of the ethmoid and lateral ethmoids developed in relation with the snout and the nasals and vomer formed in the region of the nostril. Of the bones of this region, the lateral ethmoids are replacing bones and the rest are investing ones.

The *ethmoid* (I and V-1) is a flat plate-like bone, situated on the dorsal side of the ethmoidal region. It is deeply notched medially in front and its antero-lateral ends are produced into backwardly directed processes—the *dorsal horns*. The ethmoid gets separated behind into a dorsal and a ventral plate. The space between the two plates is divided by a longitudinal septum into right and left cavities, which form the anterior ends of the olfactory capsules. The *dorsal plate* extends back into a pair of processes separated by a longitudinal slit. The processes overlie the anterior region of the frontals and the slit between them forms the front part of the anterior fontanelle. The *ventral plate* is produced on the sides into forwardly directed processes—the *ventral horns*, which lie behind the dorsal horns. The ventral plate articulates behind with the vomer.

The *lateral ethmoids* (I and V-2) are a pair of hammer-shaped prominent bones on the flanks of the ethmoidal region, outer to the ethmoid and frontals. The shaft of the hammer runs back on the outer side of the frontal articulating with it and gets connected behind to the sphenotic. The inner head of the hammer, which is broad and rounded, is overlapped by the ethmoid and frontal. A vacuity on the inner side lodges a part of the olfactory tract of the brain. The outer head is long, slender and forked. The anterior process of the fork is small and bent upwards and it articulates with the palatine. The posterior process of the fork is large and stout, which curves back and joins the head of the third suborbital.

The *vomer* (II and V-3) lies on the ventral side of the ethmoidal region. It is a large bone, which consists of a rhomboidal body and a backwardly directed stem. From the junction of the body and the stem arises a pair of backwardly directed diverging *vomerine processes*, which bear *vomerine teeth*. The body articulates in front with the ethmoid, while the stem runs back underneath the anterior third of the parasphenoid and is connected with it.

The *nasals* (I, III and V-4) are splint-like tubular bones, developed in relation with the olfactory capsules. Each lies along the outer margin

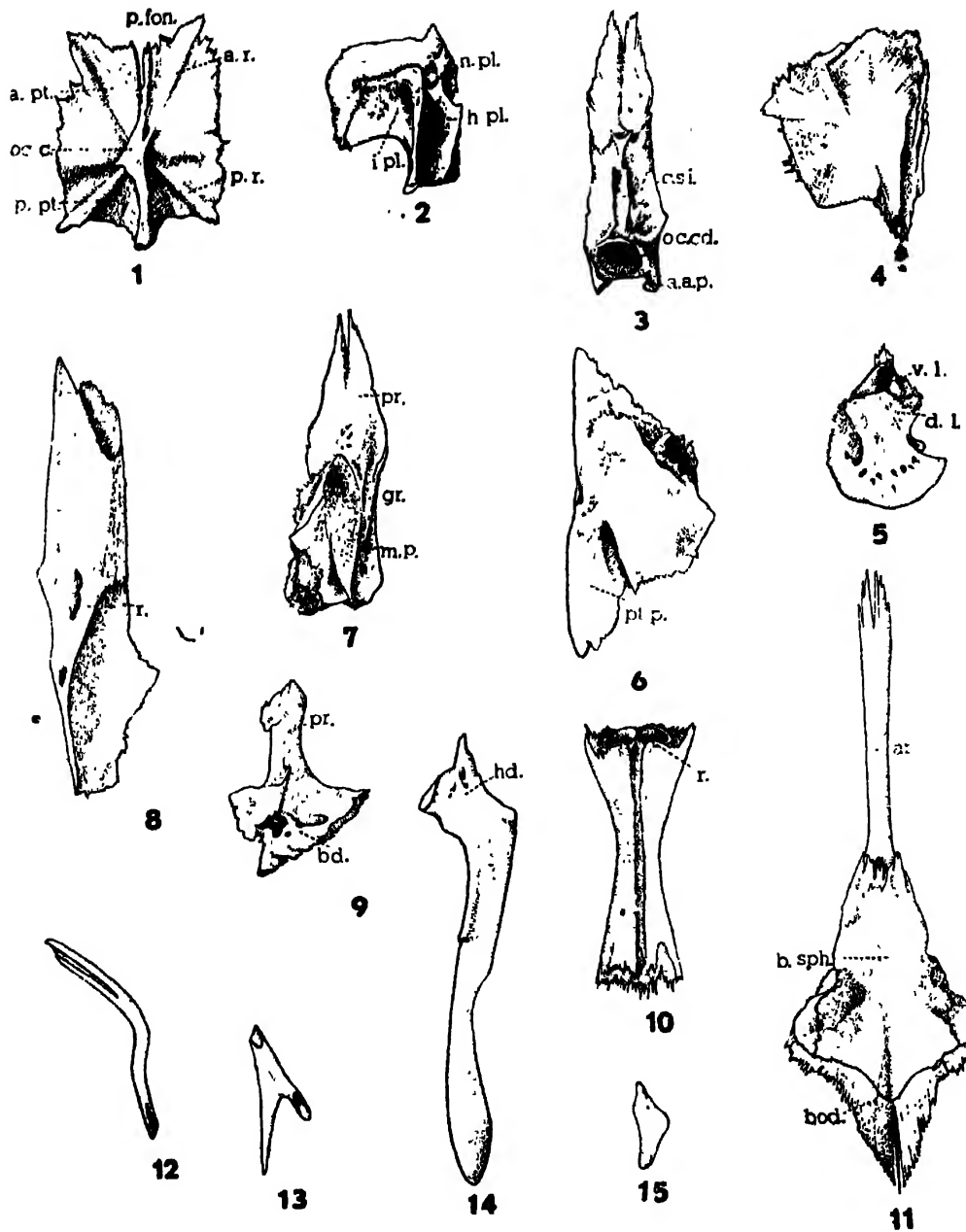


FIG. IV.

Bones of the skull disarticulated (nat. size).
(Prootic in ventral view and rest in dorsal view.)

1, supraoccipital; 2, exoccipital; 3, basioccipital; 4, prootic; 5, epiotic; 6, pterotic; 7, sphenotic; 8, frontal; 9, pleurosphenoid; 10, orbitosphenoid; 11, parasphenoid with basisphenoid; 12-15, first, second, third and fourth suborbitals.

a.a.p., accessory articular process; *a.pt.*, anterior part; *ar.*, arm; *a.r.*, anterior ridge; *bd.* & *bod.*, body; *b.sph.*, basisphenoid; *c.s.i.*, cavum sinus imparis; *d.l.*, dorsal lamella; *gr.*, groove; *hd.*, head; *h.pl.*, horizontal plate; *i.pl.*, inclined plate; *m.p.*, main part; *n.pl.*, neural plate; *oc.c.*, occipital crest; *oc.cd.*, occipital condyle; *p.fon.*, posterior fontanelle; *p.pt.*, posterior part; *pr.*, process; *p.r.*, posterior ridge; *pt.p.*, pterotic process; *r.*, ridge; *v.l.*, ventral lamella.

of the ethmoid and is embedded in the connective tissue. It encloses the supraorbital canal of the lateral line system, which terminates at its anterior end.

B. THE VISCERAL SKELETON

The visceral skeleton consists of the mandibular, hyoid, and five branchial arches. The first four branchial arches are of the usual type, but the fifth is reduced and is without gills.

(i) The Mandibular Arch

The mandibular arch is very well developed and it forms the upper and the lower jaws. Each half of the upper jaw is formed of three replacing bones—the palatine, metapterygoid and quadrate and three investing bones—the ectopterygoid, premaxilla and maxilla. Each half of the lower jaw is composed of two investing bones—the angular and dentary.

The *palatine* (I and III) is a small flattened bone, which lies on the inner side of the maxilla. It joins by front end with the maxilla and by the hind end is attached to the lateral ethmoid by muscles and connective tissue.

The *ectopterygoid* (II) is a small bone that articulates at its anterior end with the vomer above the vomerine process and behind with the metapterygoid.

The *metapterygoid* (I, II, III and V-6) is a prominent bone, which bears in front a notch for the ectopterygoid. Posteriorly its inner half articulates with the hyomandibula, while the outer half extends back and meets the quadrate and hyomandibula.

The *quadrate* (I, II, III and V-7) is a triangular bone, with its apex outwards and base inwards. The front end of the bone is distinguished into a dorsal and a ventral lamella, which meet the two similar projections from the hyomandibula. Its outer end terminates into a condyle for the articulation of the lower jaw. From the condyle arises a spine, which running along the posterior border of the quadrate articulates with the preoperculum. Its inner end articulates from before backwards with the metapterygoid, hyomandibula and preoperculum.

The *premaxilla* (II, III and V-9) is a stout bone forming the upper margin of the whole gape of the mouth. It joins in front in a symphysis with the one of the other side and behind it ends a little before the place of articulation of the lower jaw with the quadrate. On its lower side it bears numerous cardiform incurved teeth, which run in irregular rows. The teeth in the outer rows are small and in the inner rows stout.

The *maxilla* (I, III and V-8) is a poorly developed bone and lies on the upper side of the premaxilla. It consists of a bifid head and a backwardly directed arm; the former articulates with the palatine and the latter supports the barbel.

The *angular* (III and V-10) is an elongated curved bone, developed around the posterior one-third of Meckel's cartilage. Towards the proximal end it has a facet for the articulation of the quadrate and its distal half lies on the inner side of the dentary. The bone bears on the inner side a groove for the mandibular canal of the lateral line system.

The *dentary* (III and V-11) is also long and curved and it is developed around the anterior two-third of Meckel's cartilage. It meets in front in a symphysis with that of the other side and behind it terminates in a fork, which lies on the outer side of the angular. On its upper surface is a plate-like structure that bears cardiform incurved teeth. These teeth run in

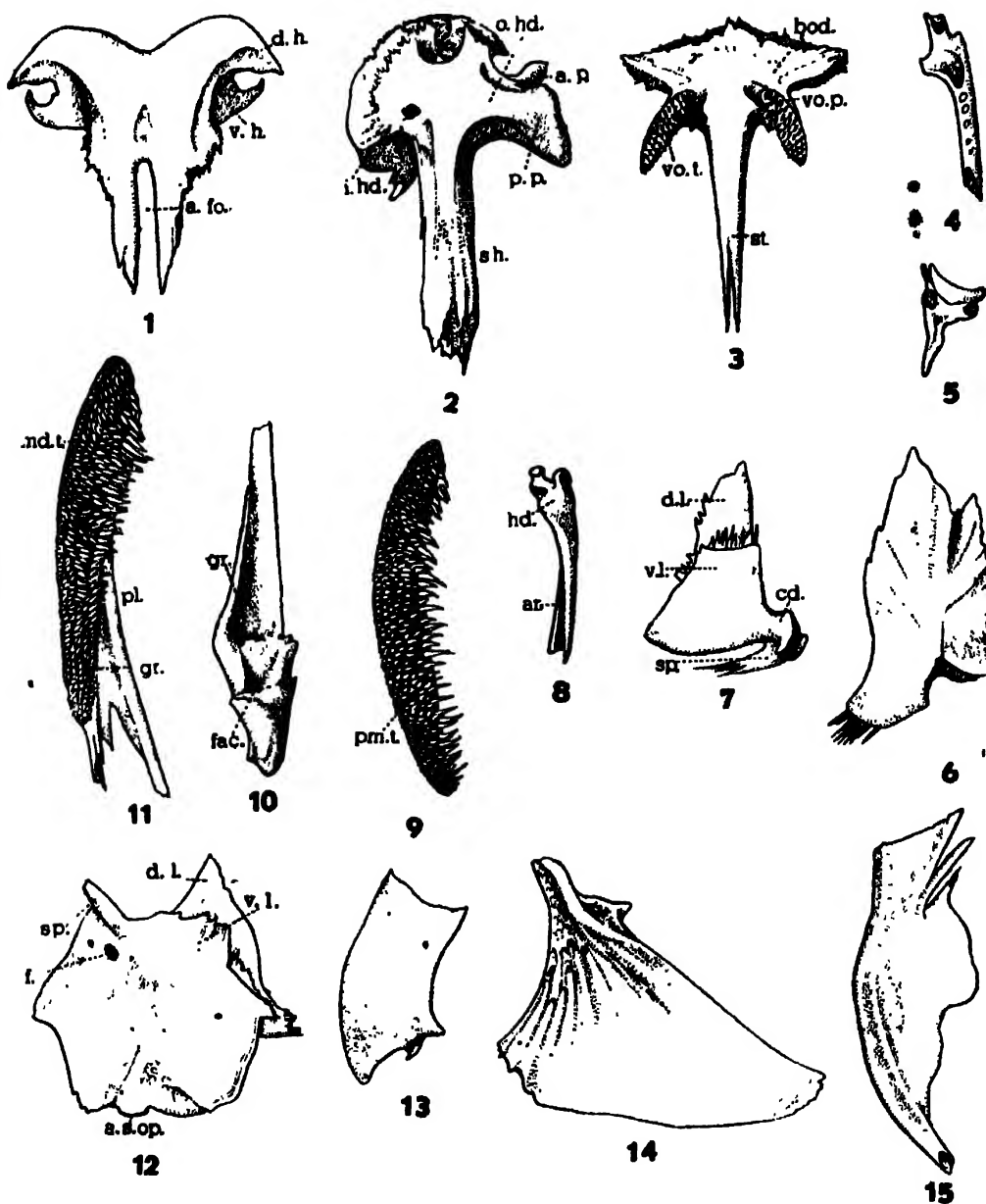


FIG. V.

Bones of the skull disarticulated (nat. size).

(Vomer, maxilla and premaxilla in ventral view and rest in dorsal view.)

1, ethmoid; 2, lateral ethmoid; 3, vomer; 4, nasal; 5, lacrymal; 6, metapterygoid; 7, quadrate; 8, maxilla; 9, premaxilla; 10, angular; 11, dentary; 12, hyomandibula; 13, interoperculum; 14, operculum; 15, preoperculum.

a.fo., anterior fontanelle; *a.p.*, anterior process; *ar.*, arm; *a.s.op.*, articular surface for operculum; *bod.*, body; *cd.*, condyle; *d.h.*, dorsal horn; *d.l.*, dorsal lamella; *fac.*, facet; *f.*, foramen of hyomandibular nerve; *gr.*, groove; *hd.*, head; *i.hd.*, inner head; *md.t.*, mandibular teeth; *o.hd.*, outer head; *p.p.*, posterior process; *pm.t.*, premaxillary teeth; *pl.*, plate; *sh.*, shaft; *st.*, stem; *sp.*, spine; *v.h.*, ventral horn; *v.l.*, ventral lamella; *v.op.*, vomerine process; *vo.t.*, vomerine teeth.

irregular rows, which in the outer rows are small. In between the plate and the bone is a narrow tunnel for the mandibular canal of the lateral line system. The dentary bears below about eight to nine pores.

(ii) *The Hyoid Arch*

Each half consists of the hyomandibula and the hyoid cornu.

The *hyomandibula* (II, III and V-12) is a prominent flattened bone, distinguished in front into a dorsal and a ventral lamella. On the inner side it glides by a long head in a groove on the sphenotic and pterotic. From the hyomandibula, in front of the head, arises a spine directed inwards over the pleurosphenoid. On the inner side of the spine the bone is perforated for the hyomandibular trunk of the facial nerve. On its posterior border it bears an articular surface for the opercular bone. The hyomandibula articulates with the operculum and preoperculum behind, with the quadrate on the outer side and with the metapterygoid in front.

The articulation of the jaws in the cranium is through the hyomandibula, but the suspensorium is *methyostylic*.¹

The *hyoid cornu* (VI) hangs from the hyomandibula by a small rod-like *interhyal*, which lies on the inner side of the preoperculum. The hyoid cornu is formed of four flattened bones—the epihyal, ceratohyal and two hypohyals.

The *epihyal* is a triangular bone, which lies on the ventral side of the head along the anterior edge of the gill cavity. It articulates behind by its apex with the interhyal and in front by its base with the ceratohyal. Along its posterior edge, it carries three to four branchiostegal rays.

The *ceratohyal* is long, being twice as long as the epihyal. It runs forwards and inwards from the epihyal along the anterior edge of the branchial cavity. It is attached by its broad hind end with the epihyal and by its narrow front end to the anterior hypohyal. It supports along its posterior edge fifteen to sixteen branchiostegal rays.

The *hypohyals* are two small bones, which lie in the same line one behind the other. The *anterior hypohyal* is triangular and it is attached by its base with the similar hypohyal from the other side and by its apex to its ceratohyal. The *posterior hypohyal* is also triangular, but it is comparatively smaller in size. By its base it articulates with the anterior hypohyal and its apex is directed backwards.

On the underside of the hypohyals, directed backwards, is a prominent urohyal. The *urohyal* is connected in front to the anterior hypohyal by its stem and widening behind ends in three unequal processes, a median long and a small one on either side. On the dorsal surface of it is a longitudinal ridge, along either side of which articulates the cleithral bone.

Connected with the hyoid arch is a gill cover² on either side. Each gill cover is formed of three bones, the operculum, interoperculum and preoperculum (I, II, III and V-13-15). The suboperculum is absent.

¹ According to De Beer (1937) the jaw suspension is *methyostylic* in Teleostomi. The articulation of hyomandibula to the auditory capsule is anterolateral to the facial nerve and dorsolateral to the head vein.

² According to Eaton (1948), the gill cover has a dual origin; its integument, dilator muscle and skeletal elements are from the mandibular operculum of the preacanthodians and the constrictor muscle and articulation of the skeletal parts are hyoidean. Its relation with the hyoid arch is a later acquisition, due to the widening of the mouth at the expense of the hyoidean cleft and the need of the jaws to be independent.

The *operculum* is a scute-like triangular bone, which hangs with its apex from the hyomandibula. Its upper surface is marked with radiating ridges commencing from its apex.

The *interoperculum* is a small scute-like bone on the inner side of the operculum overlapped by it.

The *preoperculum* is an elongated curved bone, the posterior margin of which is thickened and canaliculized for the passage of the operculo-mandibular canal of the lateral line system. The preoperculum, instead of having a firm contact with the operculum and interoperculum, is more intimately connected with the quadrate and hyomandibula. It articulates in front with the hyomandibula and quadrate, on the outer side with angular and behind overlaps the front ends of the operculum and interoperculum.

A small tubular bone lies in the cartilage between the pterotic and the preoperculum. Through it passes the operculomandibular canal in its course to the lower jaw.

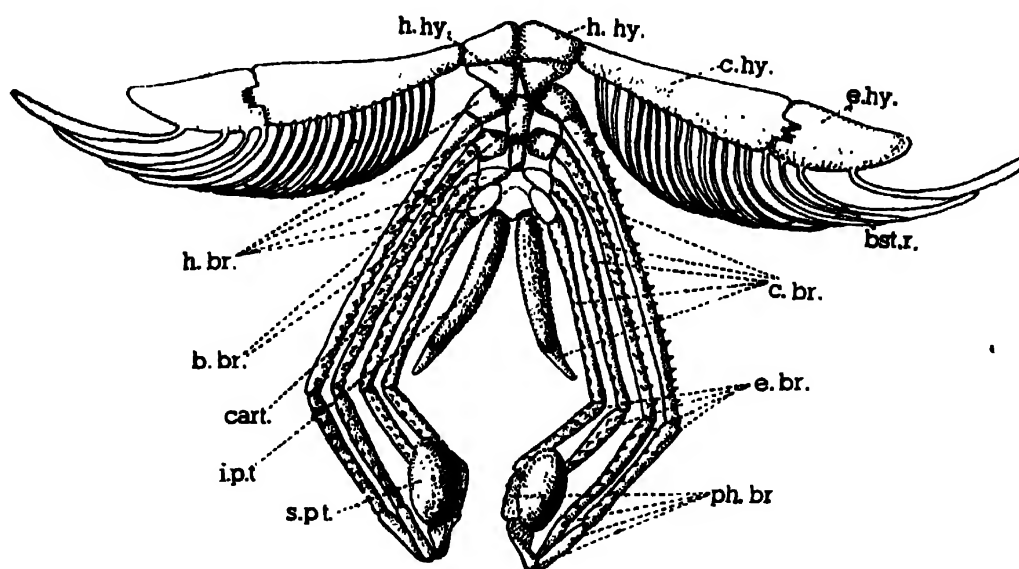


FIG. VI.

The visceral skeleton ($\times \frac{1}{2}$).

(Opened out for the sake of clarity.)

b. br., basibranchial; *bst. r.*, branchiostegal ray; *cart.*, cartilage; *c. br.*, ceratobranchials; *c. hy.*, ceratohyal; *e. hy.*, epihyal; *e. br.*, epibranchials; *h. hy.*, hypohyal; *h. br.*, hypo-branchials; *i. p. t.*, inferior pharyngeal teeth; *ph. br.*, pharyngobranchials; *s. p. t.*, superior pharyngeal teeth.

(iii) The Branchial Arches

Each half of the branchial arch is ossified by the pharyngobranchial and epibranchial in the upper part and the ceratobranchial and hypobranchial in the lower part. The two halves of an arch meet in the mid-ventral line on the median basibranchial.

The *pharyngobranchial* (VI) is a small rod-like bone, which lies obliquely in the dorsal wall of the pharynx. At its anterior end it is attached by ligaments to the prootic bone and at its posterior end with its epibranchial. The first three of the pharyngobranchials are of the usual type, while the fourth lies forward sharing the posterior end of the third pharyngobranchial with the third epibranchial.

The *epibranchial* (VI) is an elongated curved bone, which is grooved on its upper surface and bears a double row of gill rakers on the underside.

It extends backwards to its ceratobranchial. Over the fourth pharyngo-branchial and the third and fourth epibranchial is an oval pad bearing fine *superior pharyngeal teeth*.

The *ceratobranchial* (VI) is a long curved bone, more than twice as long as the epibranchial and directed forwards. It is grooved on its lower side and bears a double row of gill rakers on the upper side.

The fifth arch is represented by a pair of ceratobranchials only. Each is expanded in its greater part into a plate-like structure, which bears fine *inferior pharyngeal teeth*.

The *hypobranchials* are distinct in the first four branchial arches. The first and second hypobranchials are ossified and the third and fourth are cartilaginous. They articulate on the outer side with their ceratobranchials and on the inner side the first two with the anterior ends of their basibranchials and the remaining with a median cartilage.

The *basibranchials* are also not ossified in all the arches. There are usually two of these in the form of rods, which ossify in the median cartilaginous copula of the chondrocranium, one behind the other. In old and large specimens a third cartilaginous basibranchial lies behind the second and it articulates with the third and fourth pair of hypobranchials.

II. SUMMARY

1. There are two fontanelle in the cranial roof, the anterior lying in the ethmoid and between the frontals and the posterior situated between the frontals and in the supraoccipital.

2. There are no parietals, opisthotics, symplectics and suboperculars. The orbitosphenoid is a median bone, formed from paired ossifications. It is hollow and divided in front into two lateral channels by a ridge. A distinct basisphenoid, intimately connected with the upper surface of the parasphenoid, is present. There is a gap in the cranium on either side, bounded by the pleurosphenoid, prootic and parasphenoid, for the passage of the oculomotor, trochlear and abducent nerves and for the infraorbital and hyomandibular trunks of the trigeminofacial complex. Another gap between the pleurosphenoid and the parasphenoid is for the passage of the optic nerve.

3. The auditory capsule is formed of two recesses, the anterior furnished by the prootic, exoccipital, epiotic and pterotic is for the utricle and the three semicircular canals, while the posterior bounded by the basioccipital and exoccipital is for the sacculus, lagena and cavum sinus imparis.

4. The palatines are reduced and take no part in the movement of water through the olfactory capsules. The maxillae are also reduced and act as basal supports for the barbels.

5. The suborbitals run in a chain, behind, below and in front of the eye. The third suborbital is very stout. Its head lies in between the second and fourth suborbital and the rest extends back and joins the quadrate and angular at the angle of the mouth.

6. The pterygoid is absent. The metapterygoid is well developed and a small ectopterygoid lies between it and the vomer.

7. The angulare and dentaries are only developed in the lower jaw.

8. The preoperculum articulates with the hyomandibula and quadrate. The operculum and interoperculum are not well developed.

9. Each ramus of the hyoid arch has two hypohyals, the basihyal on it being absent. The fifth branchial arch is reduced to a pair of ceratobranchials. The hypobranchials and basibranchials in the third and fourth arches are not ossified. The basibranchials are usually two but may be

three also. Over the fourth pharyngobranchial and the third and fourth epibranchial is a pad of superior pharyngeal teeth and over most of the fifth ceratobranchial are the inferior pharyngeal teeth.

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HUMAN SETTLEMENT AND OCCUPATIONAL ECONOMY IN GARHWAL-BHOT HIMALAYAS

By S. D. KAUSHIC

(Communicated by Prof. N. K. Bose)

Garhwal-Bhot is a trans-Himalayan region, consisting of longitudinal and transverse trough-valleys lying south of the Great Himalayan Range, behind the ice-capped line of the highest peaks of the world. It comprises the longitudinal valley of the uppermost reaches of the Bhagirathi, and transverse valleys of the Saraswati and Dhauliganga rivers.

This region is inhabited by roving trader-cum-pastoralists who go for trade to the Tibetan marts in summer and cis-Himalayan marts in winter. They rear flocks of sheep and goats for the wool industry as well as for carrying merchandise to Tibet.

ENVIRONMENTAL SETTING

The topography of the Bhot region is highly precipitous. It is sculptured by glaciers. Serrated crests of high ridges, cirques of glaciers, bridges of unmelted ice, snow-covered slopes, hanging valleys, cascades of sparkling water coming from melting ice, torrential rapids, and gigantic escarpments comprise a gorgeous topography. Deep canyons, roaring streamlets, huge boulders, morainic deposits and glistening lakes present a beautiful scenery.

Sky-penetrating ranges segregate the valleys from one another, while the isolated deep glens create a vague consternation in the mind of man. The pervading dreadful silence is often broken by thundering avalanches, which strike terror in the heart of the traveller. Yet, it has its own unsurpassable grace and charm, with the sweet melodies of beautiful birds of variegated hues, magical beauty of the enchanting flowers donating liberally their exuberant fragrance to the breeze, and the heavenly scenes of sunrise and sunset filling clouds and ice-peaks with the wealth of gold.

In spite of blizzards and hailstorms in winter, the climate of the Bhot region is very invigorating in summer from May to September; and it is during these months that the Bhotia people live in their summer habitations in this zone.

The altitude of the region varies between 10,000 and 20,000 ft. Just north of the main river valleys of Dhauliganga, Saraswati, Jambhavi and Jalandhri Ganga, there are mountain passes in the Tibetan range at heights above 16,000 ft. Through these passes, the Bhotia traders carry on their trade.¹

Human habitations in the Bhot region exist only along the river valleys, else the mountains are barren. Each river valley is a geographical and cultural unit by itself, because lofty and uncrossable mountains as well as glaciers segregate them from one another. No other part of the world is so highly rugged, and 'such is the irregular appearance of the mountains, that it is the line of the river valleys alone that enables us to find a clue to their arrangement, and it is precisely along these rivers that the Bhotia village lies'.²

The climate of the region is alpine. The mean temperatures of the two hottest months of July and August remain below 58° F. The whole of this area is buried under snow for about seven months every year, from the end of October to the last week of May; and the seasons of spring, summer and autumn occur within a short compass of only five months. In the daytime in summer, on account of rarefied atmosphere, the sunshine is scorching; and there is a great difference in the temperatures under sun (90°–100° F.) and under shade (below 65° F.).³

Garhwal-Bhot region lies beyond the reach of the monsoons, hence it is an area with annual precipitation between 10 and 20 inches. Precipitation comes mostly in the form of snow from winter depressions; however, there are local convectional rains in summer and showers are experienced practically every afternoon from June to September, the total fall for the summer being 8 to 10 inches, including the snowfall in summer nights.⁴

The flora of this region is coniferous up to 12,000 ft. Forests of deodar, blue pine, spruce, silver fir, cypress and yew cover the ridges and spurs. Above 12,000 ft., coniferous trees decline; then, birch and juniper-bush extend up to 13,000 ft. This is the timber-line, and alpine pastures extend beyond it up to the snow-line at 13,500 ft. In summer months, Bhotia people graze their sheep, goats, mules and jibus on these alpine pastures. From November to May, these pastures remain under snow.⁵

SUB-REGIONS OF GARHWAL-BHOT

Garhwal-Bhot region consists of 3 sub-regions:—

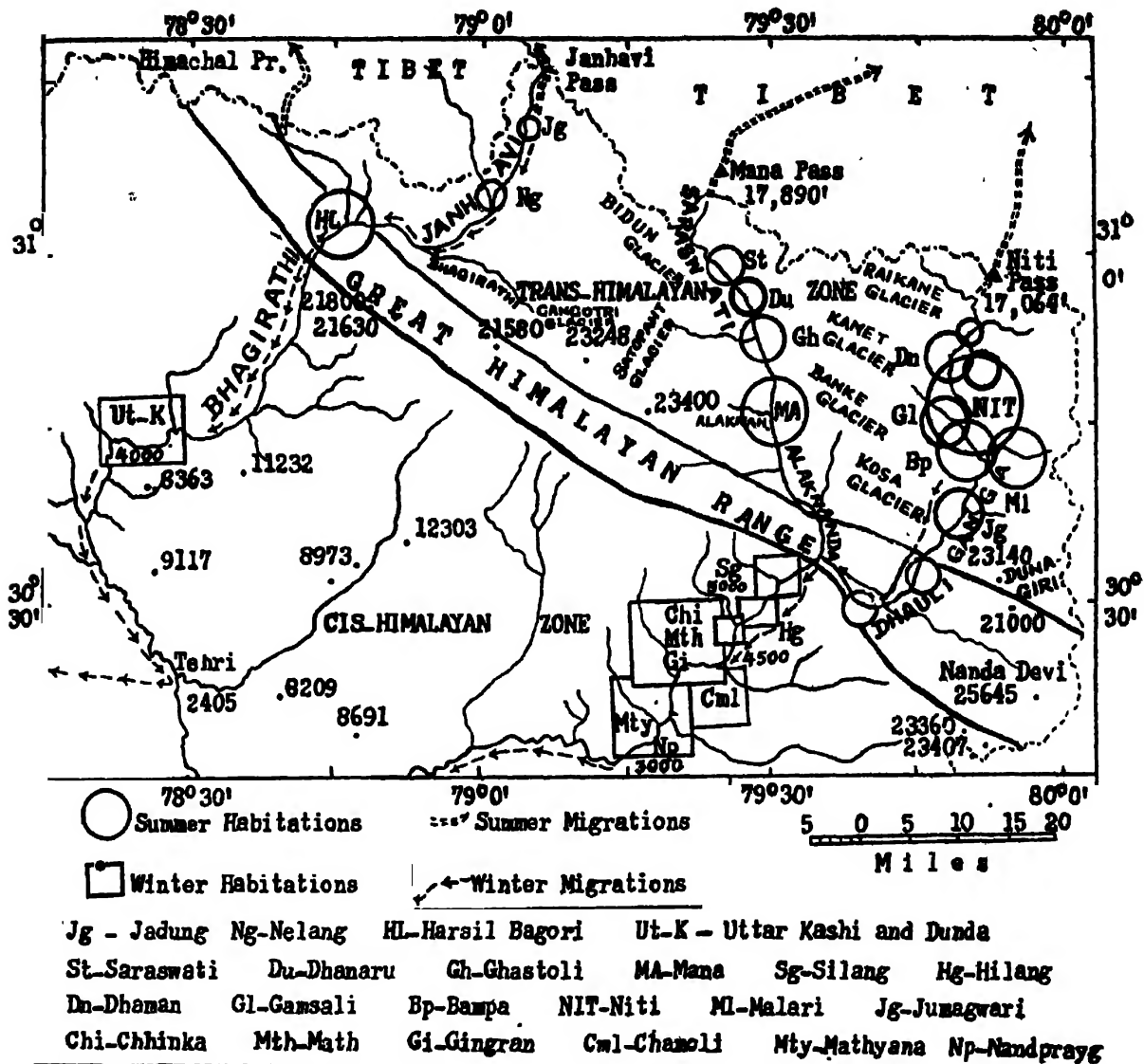
- (1) Janhavi Bhot (Janhavi or Jad Ganga Valley);
- (2) Mana Bhot (Saraswati Valley);
- (3) Niti Bhot (Dhauli Ganga Valley).

Janhavi region is separated from the Saraswati region by the six glaciers of Kedarnath, Gangotri, Mana, Bidun, Bhagat-Kharak and Satopanth. The Saraswati Valley and Dhauli Ganga Valley are crossed by the Zaskar Range, and separated by six glaciers of Kamet, Raikana, Banke, Kosa, Juma and Kankalbank. Thus, the three valleys are isolated and form self-supporting entities. Each valley has developed its own social codes, yet the fundamental features of habitational ecology are common to all the three valleys, and the Bhot environment has forced the people of the whole region to adopt certain common ways of adjustment and occupation.

HABITATIONS IN BHOT REGION

The main forces which determine the site, size, pattern and functions of habitations are the natural and cultural milieus. Regional location, topography, climate, soil, aspect of the slope (sunny or shady), conditions of water-supply and irrigation, natural flora of the region and the carrying capacity of land, all join hands in prescribing the types of agriculture, pasturing and forestry. These occupational industries, in their turn, combine with the above factors in resolving the types of human settlement, in the form of hamlets, villages or towns, and also in the form of permanently settled habitations or seasonal abodes and encampments.

In the Himalayas, animals render a great service to man, in his adjustment to the environment. A Bhotia trader-pastoralist's flocks of sheep and goats are deeply related to his life. They not only provide him with meat for his food and wool for his clothing, but also serve as carriers over the ridges, glacial tracts, and mountain fastnesses.



The three river valleys of the Garhwal-Bhot Himalaya, and their seasonal habitations in summer and winter.

The inhabitants of the Bhot region are all nomadic, their main occupation being trade and pastoralism. Agriculture is only a subsidiary occupation; wool spinning and weaving is their long established cottage industry. They trade between Tibet and the cis-Himalayan region. People of each valley have their fixed marts in Tibet and the sub-Himalayan zone.

There are two types of human settlement in this region:—

- (i) Ribbon-like settlements consisting of permanent houses;
- (ii) Shifting encampments during the seasonal migrations from lower valleys to the highest habitations in summer and vice versa in winter.

Bhotia people possess two or three sets of habitations lying in different climatic zones for different seasons. Their family structure, community organization, social codes and culture are also the outcome of age-old adjustment to their surroundings. A long range of superstitions, the use of magic as an aid to living, and the inclusion of spirit-worship in their Hindu-Buddhistic religion can all be observed in operation in their settlements and encampments.

In the summer months, from May to October, they live in their homes in the alpine zone, between 9,000 ft. and 19,000 ft., and in the winter they live in the warmer valleys below 6,000 ft. During their upward and downward marches, they live in temporary encampments. Their permanent houses have been in use for generations. The summer houses situated in the trans-Himalayan zone contain their inherited belongings of centuries. The villages of Niti, Malari and Mana are famous for their copperware inherited from their forefathers. While migrating to lower valleys, all furniture is left in the summer houses; big utensils and surplus grain are preserved secretly in excavations in the open ground, covered with rocks, gravel, etc., so that Tibetan robbers may not steal them during winter when these Bhotia villages remain deserted. On returning again in May or June, these belongings are dug out and brought to use.

These summer houses are the bases of trade with Tibet. Grain, flour, sugar, tea, cloth and other merchandise brought from the cis-Himalayan region are first stored in these summer houses. Afterwards they are carried to Tibet. Only sturdy men go to Tibet, while women, children and old men live in these houses from June to September.

ALTITUDINAL ZONE OF MAXIMUM SETTLEMENT

The summer habitations lie all above 9,000 ft., and most of the habitations exist between 10,000 ft. and 12,000 ft., although some of them are situated even above the height of 16,000 ft. or 17,000 ft. Between 10,000 ft. and 13,000 ft., there are vast stretches of pasture lands which provide grazing to the flocks of sheep, goats and other pack animals of the Bhotia people. Winter habitations are all situated below 6,000 ft. The maximum number of winter settlements lies between 4,000 ft. and 6,000 ft. The chief summer and winter residences of the three valleys of Garhwal-Bhot are given below.

Summer habitations				Winter habitations	
Janhavi or Jad Ganga Valley :				ft.	
Harsil-Bagori	9,000	In Bhagirathi Valley between 4,000 ft. and 6,000 ft., Dunda, Nakuri, Uttar Kashi, etc.	
Gartang ..	..	..	11,000
Jadung ..	..	..	12,200
Purnam Sumada ..	..	..	14,000
Dharali ..	..	..	10,000
Nelang ..	..	..	11,400
Sonam Wasa	13,000		
Saraswati or Mana Valley :				ft.	
Mana	10,600	In Alaknanda Valley near Haat, Gingran, Mathyana, Pandu- kesar, and also near Joshimath.	
Sum Janka ..	..	..	12,800
Dhanaru ..	..	..	13,900
Rata Kana ..	..	..	16,500
Musapani ..	..	..	12,600
Ghastoli ..	..	..	13,000
Saraswati	16,000		

Dhaulī Ganga or Niti Valley :		ft.	
Jumagwari, Kaga, Kosa, Garpag, Jēlam		9,000	In Alaknanda Valley,
Gamsali .. .. .	.. .. .	11,300	between 5,000 ft. and
Bimlas .. .. .	.. .. .	12,000	6,000 ft.—Siya Sain,
Damjan .. .. .	.. .. .	12,500	Haat, Chhinka, Gin-
Rai Kane, Kharbe .. .. .	.. .. .	13,500	gran, Mathyana, etc.
Kiung lung .. .. .	.. .. .	14,800	
Malari .. .. .	.. .. .	10,000	
Bampa .. .. .	.. .. .	11,000	
Niti .. .. .	.. .. .	11,500	
Goting .. .. .	.. .. .	12,500	
Dhaman .. .. .	.. .. .	12,700	
Gildung .. .. .	.. .. .	14,500	

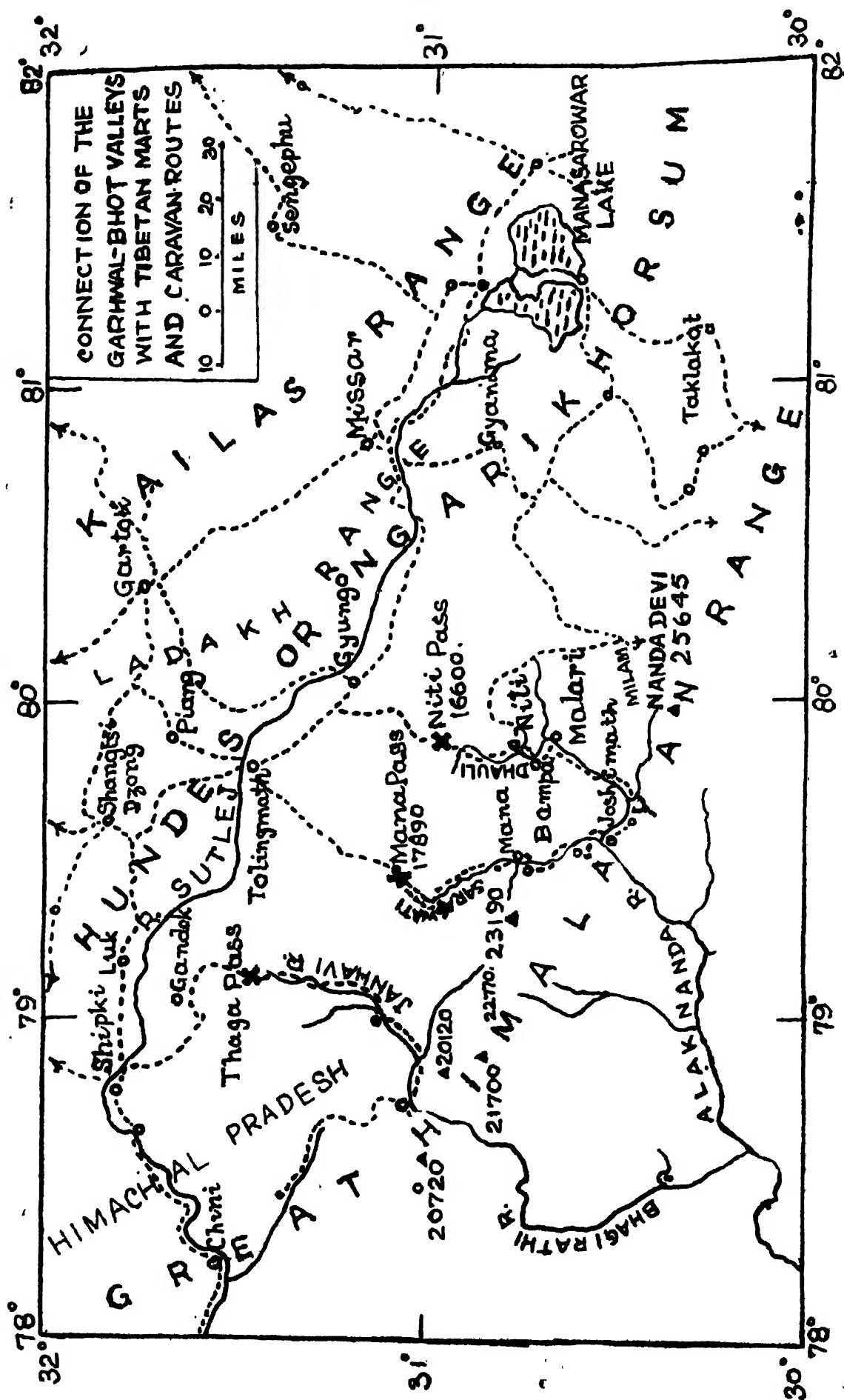
An ordinary village consists of 200 to 300 inhabitants. The total population of Garhwal-Bhot region is 10,620, spread over an area of 2,540 sq. miles. The density of population is less than 6 per sq. mile. As agriculture is only a supplementary occupation, only about 25 sq. miles are cultivated in the whole region.

ENCAMPMENTS DURING THE JOURNEY TO SUMMER RESIDENCES

Before the upward march in April, some auspicious day is fixed by the village astrologer for the journey to trans-Himalayan residences. The whole hamlet or village has to march in family groups. Two or three days before the start, all food grains and other merchandise to be carried are packed in saddle-bags, according to the number of carrier animals, which are sheep, goats, mules or ponies. Pack-saddles of goats and sheep, called *Karbozas*, are small bags to hang on both sides from the back. Goats and sheep are loaded and sent with drovers a day before. Most of the night-time passes in the worship of family deities and other gods. Early in the morning, the household goods, utensils, etc., are loaded on the backs of mules. Women and children start first. Young children and babies are carried by their mothers or elder sisters. These children are tied to the back with pieces of cloth. Women without babies have to carry some handy articles packed in ringal-bamboo baskets on the back. Family dogs accompany them or are sent with the goats and sheep. Last of all marches the head of the family, with his mules and ponies.

In this way, there migrates a long caravan of animals and persons. Sturdy males and old men, women and children, shepherd drovers and dogs, mules and ponies, sheep and goats, all migrate joyfully to their summer habitation. An average trader possesses 150 to 250 sheep and goats and about a dozen mules and ponies.

After marching for 6 to 8 miles, the caravan stops at a halting place, near some source of water and forage for the animals. Family tents are pitched there. Women begin to collect fuel, and after return prepare food. Shepherd boys also help women in the work of bringing fodder and fuel from the forest. Midday meal usually consists of boiled hilly millets, meat and roasted or boiled potatoes. Afternoon tea is taken with *sattu* which is fried barley or *phaphra*, ground into flour. Men and women spin wool with small whorls whenever their hands are not engaged otherwise. In the night, every tent lights its own campfire, around which all the members of the family sit together for warmth, chit-chat and supper.



After supper, all fires are extinguished. The whole encampment lies silent, and the family dogs guard the tents.

Next morning, at about 4 o'clock, the same process of packing, loading and marching begins again. Some rich traders, who carry large quantities of merchandise for Tibetan trade, arrange intermediate camps. Bags of goods are first stored in these intermediate camps, and afterwards shifted to the alpine residences. In two or three trips, all goods reach the Bhot villages.

RESIDENCE IN SUMMER HOMES

On reaching the summer bases of trade, loads of merchandise are stocked in the store-rooms, which form a part of the residential house. Animals are sent to pasture and people feel relaxed after a tiresome journey.

The main items of food in Bhot region are *sattu*, meat and hot drink. Their tea is salted, buttered and thoroughly churned in a hollow bamboo, called *dhomo*, of about 4 inches diameter and 3 feet height.

On account of the cold climate of the region, Bhotias have to wear woollen clothes all the year. Men's dress consists of a long coat, trousers and woollen cap. Women wear a long-cloth over the trousers and shirt; their head-dress is either a woollen scarf or a woollen cap with a scarf hanging down from it.

Bhotias are sturdy people and accustomed to lead a hard life. They are fair complexioned, possessing ruddy cheeks. They are honest, thrifty and enterprising. Although they are itinerant, yet their standard of living is higher than that of the settled farmers of the Garhwal Himalayas.

Their alpine pastures, called *bugyal*, lie between 10,000 ft. and 13,000 ft. They provide very nutrient fodder to the herds of sheep, goats, mules and jibus. These animals are looked after by shepherds, who are either lads who belong to the owner's family or are hired servants. They erect temporary chalets on these pastures. The life of these shepherds is very hard. They have to move from pasture to pasture and face the fury of storms and blizzards. In some pastures, there is also danger of wild animals, and the flocks of animals are penned in shelters during the night. These enclosures are made of rubble, with such a narrow gate as would allow only one sheep or mule to pass in or out at a time. Here, the dog keeps watch during the night. A Himalayan dog is very ferocious; he wears an iron band, about 6 inches broad, round his neck. It protects the dog in fight against a panther or tiger. The verdure of these pastures is so nutritious that only after grazing there for 2 or 3 weeks, the weak and famished animals recover fully. They become fattened and ready for the Tibetan journey.

AGRICULTURE

Agriculture, here, is only a subsidiary occupation. In most fields, the hoe is found more useful than the plough. On account of the steep slope, field-terraces are very narrow; but, in some tracts near Harsil-Bagori, Mana, Bampa, Malari and Niti, there is good cultivable land where the plough can be used. The summer rainfall being scanty, less than 15 inches, all crops have to be irrigated. Small streamlets coming from glacial thaw are diverted into the terraces, which are repaired with great labour every year. In winter, when the whole region remains deserted, there occur great avalanches and landslides. A million-ton heavy glacier may come sliding down a valley, and furiously sweeps away rocks and trees and demolishes not only the field but, sometimes, even the roofs of houses in a village. Mule tracks and foot-paths are destroyed, and all

communication becomes blocked. To protect the villages from avalanche, people put up fences of stone or wood, and plant hedges of bushes. They protect these hedges with a religious fervour.

Glacial soils are not very fertile; the fields are manured with the dung of sheep and goats. Some soil samples of Bhot region were analysed by the author who found the following average percentages of some important soil-elements:—

Mana Valley soils					
Org. N	..	0.10 to 0.25%	pH	..	6.0 to 6.2%
C/N	..	6.9 to 8.4	CaO	..	0.27 to 0.45
P ₂ O ₅	..	0.12 to 0.29	MgO	..	0.72 to 1.23
K ₂ O	..	0.61 to 0.92			

The soils and climate permit the cultivation of only hardy and quick maturing crops of *phaphra* (*Fagopyrum tataricum*), barley, Tibetan barley (*Hordeum himalayense*), *marsa* (*Amaranthus frumentaceus*), beans and potatoes. These crops are sown in the month of May or June and harvested in September. Before going to Tibet, the men plough the fields and sow them. Then, the fields are left to the care of the women who are responsible for watering, reaping, harvesting, threshing and winnowing.

The region does not grow enough cereals to support itself. The *per capita* food production of this region is less than 5 ounces per day. Large quantities of rice, wheat, barley, *mandua*, other hilly millets and flour are imported from the Bhagirathi-Alaknanda zone and the Dun Valleys. Food grains are imported also for trade, and surplus stocks are sold in the Tibetan markets.

WOOL INDUSTRY

The inhabitants of the Bhot region are famous for their cottage wool industry. Their flocks of sheep and goats supply wool of good quality. An average family possesses from 150 to 150 sheep and goats. There are two shearings every year, in March and September. The yield of wool per sheep is 3 lbs. to 3½ lbs. Besides this, wool is also imported from Tibet and woven into fine woollen stuff by Bhotia women who have become very dexterous in this craft.

Before carding, wool is washed and dried. For carding, they have adopted a very crude method of beating the wool with a ringal-bamboo stick. It is the work of women; but, spinning is done by both men and women. Spinning during all waking hours, when the hands are free from other work, has become a social tradition for all. There are no spinning wheels, the whorl alone being used. Weaving is the work of women, who weave fine stuff of various designs, even with very crude, primitive implements. There are two types of loom, one for simple texture and another for flowered texture. But both the types are quite simple (Fig. 6).

Blankets, *lohi*, shawls, *pankhi*, *lava*, *barmol*, *bendi*, *gudma*, *thulma* and *pashmina* are the most famous textiles prepared for different uses. Large quantities of woollen goods are sold at the sub-Himalayan marts.

LAYOUT OF THE VILLAGE

The layout of houses in Bhotia villages is exemplified below, by the account of two typical villages, (1) Harsail-Bagori in the Janhavi Valley, and (2) Mana village in the Saraswati Valley.

1. *Harsil-Bagori*.—The village of Harsil-Bagori is situated at the confluence of the Jalandhari Ganga and Bhagirathi. The older site of Harsil lay on a lower ground than the present site. About the end of the nineteenth century, a heavy flood in the Jalandhari river washed away the old village of Harsil and there was a heavy loss of life and property. Then the new village of Harsil-Bagori was founded on higher ground.

The houses are clustered in a compact fashion; but a compound wall separates each house from another. The houses are rectangular in shape, with roofs sloping at about 40°. They are two-storeyed. The lower storey is made of stone and rubble, while the upper storey is built of deodar planks, and roofed with shingles. The lower storey serves as the stall of the cattle, in which fodder and fuel also are stocked. Fuel is collected for the summer stay of five months. When the animals are sent to pasture, the lower storey is used only for storing fuel. The upper storey consists of three parts. One part is a big room, used as the summer depot of trade. Bags and packages of merchandise are stocked in this room. Another part is a long room used for sleeping and storage of domestic goods. The third part is the kitchen. In many houses, the kitchen is a part of the lower storey. Each house has an open courtyard in front of it. It is used for drying or threshing grain, drying wool, carding, weaving, basking in sunshine, or any other work connected with the wool industry. It is also used for holding feasts, performing marriage ceremonies and religious rituals.

For the flocks of sheep and goats, there are open enclosures, built separately from the house. These enclosures have walls of rubble and timber gates.

• Every village has a temple. The style of architecture resembles that of Buddhistic pagodas, in which there is a blending of Indian and Tibetan influences. Near the temple are placed some stone slabs with inscriptions of hymns from Buddhistic scriptures, the most common inscription being *Om Mani Padme Hum*. In front of the temple, two or three piles are erected for flying the flags of deities, who may be the presiding deity of the clan, village or locality.

Near the temple of Harsil, there is a wide stretch of flat land, which is used for holding fairs. Flocks of sheep and goats also take rest there on their way to or from pasture. When the men start on their Tibetan trip, women and children escort the departing traders up to this temple, situated just at the fringe of the village, near a streamlet.

2. *Mana village (Saraswati Valley)*.—Mana lies above Badrinath, near the confluence of the Saraswati and the Alaknanda rivers. The village is situated above the timber line, therefore both the storeys of houses are made of stone. The walls are plastered with coarse mud. The roofs are made of slate, and only rich traders have been able to thatch their houses with shingle, because the natural flora of the locality comprises alpine bushes and grasses, and wood even for beams is brought from the lower valleys below 10,000 ft.

The houses are so situated that only their upper storey is visible; their lower storeys lie in a depression. To avoid cold blasts, the doors are made very small, and there are hole-like openings in the walls as an apology for windows. Although the houses are situated in tiers, descending like staircases, yet their courtyards are so arranged that persons sitting in the courtyard of one house cannot be seen by the people of another. Each has some open space near it for basking, drying grain or weaving woollen cloth.

The village has two temples. Both are very small and are low domes made of stone. One is situated in the middle of the village and is dedicated

to the village god. The other is about a mile away, where the goddess *Mai*, or Mother, is enshrined. A big fair is held annually near this temple in the month of August (Bhadrapad).

The houses of the Niti Valley are also two-storeyed. These trader-pastoralists of the Niti Valley are, on the whole, richer and much better off than the people of any other Bhot valley.

TRADE TRIPS TO TIBET

The traders of Bhot usually make two trips to Tibetan marts every year. Snow melts and the passes are open by the end of June. The first trip is undertaken in the first half of July; returning herds of pack animals bring loads of wool, rugs, skins, and yak hair. After the arrival of the Tibetan wool, women are very busy washing, drying, carding and spinning it. The second trip is undertaken in the month of August or early September. Then, not only wool and skins are brought from Tibet, but also Tibetan sheep, ponies and yak.

The journey to Tibet is extremely hard and risky. For a trade trip, an auspicious day is fixed by the village astrologer. A day before, the family gods and other gods are appeased. There are prayers and feasts. Animals are called back from the pastures. According to the capacity of the carrier animals, merchandise is packed into saddle-bags. A goat or sheep carries 10 to 12 seers, and a mule or jibu from 1 to 2 maunds. Hilly millets, *mandua*, *phaphra*, *ogal*, *marsa*, barley, rice, flour, sugar, tea, dried milk, matches, tools, cotton cloth, and general merchandise are carried to Tibet. Each traveller takes with him provisions for the journey. The usual food consists of parched flour, fried meat and salted tea. Heavier loads consisting of iron goods, copper ware, tools, cloth, and even grain, are carried by mules or ponies or jibus. A jibu is a cross between yak and mountain-cow. It is very hardy, and can be used both in cold Tibet and the warm sub-Himalayan valleys as a pack animal as well as a mount.

After loading the animals, the trader starts on the Tibetan journey very early in the morning. Women and children walk up to some watering place to bid farewell to them. There rises a tide of affection in the whole village. Tibetan trips are often full of fear of lawless bandits; so, these traders equip themselves with necessary arms to protect themselves and their property. They always travel in groups of twenty to thirty. This group life lessens the drudgery of the tiring journey.

On crossing the Indo-Tibetan border-line, certain formalities are fulfilled regarding the payment of trade-taxes and assurance of importing no disease into Tibet. In Tibet, there are separate marts for the Bhotias of different valleys. Janhavi Valley traders go *via* Jelukhaga Pass (17,480 ft.) or Nala Pass to the markets of Gandok and Chusumath. Mana Valley traders go *via* Mana Pass (17,890 ft.) to the markets of Tholingmath and Chhaprang. Niti Valley Bhotias go *via* Niti Pass (16,600 ft.) to the marts of Dapa, Nabra and Dongpo. With special licence of trade obtained at Dapa, these Niti Valley traders can go to the marts of Dam, Chogla, Shib Chilam and Gartok. Tibetan wool, rugs, skins, sheep, and ponies are bought in exchange for goods carried from the cis-Himalayan region. The second trip is over by the end of August or early in September.

After arriving from Tibet, the animals are once again sent to pasture. Men take rest for about a fortnight. Women reap and then thresh out grain. Now, preparations are made for the downward march to winter residences, and by the end of October (after celebrating the festival of

epawali), the villages are deserted to remain under snow for about seven months.

WINTER RESIDENCE

During winter, Jad Ganga Valley traders live near Dunda and Uttar Kashi, while the people of Mana and Niti valleys live below Joshimath, near Chhinka, Mathyana, etc. In these winter habitations, they camp from November to April. It is during this period that trade-fairs are held at Uttar Kashi and Nand Prayag. Merchants dealing in woollen goods come from far off towns in the plains to buy wool, *pasham*, blankets, *lohi*, *pattu*, *gudma*, *pankhi*, *barmot*, etc. Whatever stocks remain unsold are brought to Dehra Dun, Kotdwar and Ram Nagar. Some rich Bhotias go on long trips to Delhi, Amritsar and Kanpur to sell wool.

COMMUNITY ORGANIZATION

The community life of the Bhotia people is controlled by long-established traditions, social codes, religious beliefs and superstitions. During the journeys, the whole family marches together; all the members of the family co-operate in the performance of various works connected with the daily march and encampment.

An efficient division of labour and mutual co-operation has evolved there after centuries of experience. Because they have to change the abode seasonally and practically all life passes on the road, they have the minimum amount of furniture and luggage. Trade merchandise, rations, wool and woollen goods comprise the main loads to be carried. Their tents are light and very light utensils are used in the encampment. Every item of equipment is determined by considerations of portability and ease of handling. Utensils are so curiously designed that they can be inserted one into the other, and the whole set can be contained in a bag. Every family possesses 6 or 7 goatskins and woollen bags for packing goods.

A Bhotia traveller is a keen observer of nature. He leads his caravan of pack animals across the labyrinths of overlapping spurs and glens very carefully, and possesses a human sympathy for every goat or sheep which meets an accident or happens to be in need of being relieved of the load-bag. Sometimes, many of his sheep and goats suffer from hoof diseases or get lame. Then he faces the emergency cheerfully. He relieves the suffering animals of their pack-loads and makes them move slowly in the charge of an escort.

He is sure-footed to follow his track over precipices and, if he happens to miss his way in any blizzard or mist, then, his animals help him. They always seem to know the right way even in rain, storm, hail or mist, if they have once trodden over the track.

Spirit worship is prevalent in all the three Bhot valleys. The environment is fearsome, because the mountain fastnesses isolate the valleys and there pervades a dreadful silence, which is often broken by terrific thunders of avalanches and roaring echoes of landslides. Shrieks and eerie sounds create a vague sense of fear in the mind of man, who becomes god-fearing and imaginative, and looks upon every crag and forest corner as the seat of some deity. Spirits are believed to haunt and rule over the different vales and ridges, and the Bhotias perform their traditional rituals to appease the spirits.

Now, under the development schemes of the government, schools of itinerant type are being opened in these valleys. These are primary schools

and migrate with the Bhotias. For wool industry also, new types of hand looms are being introduced in winter habitations like Chhinka, Math, Gingran and Dunda. The spinning wheel is also seen in some advanced and big families, although the spinning whorl cannot be totally abandoned, because it is the only handy method of spinning even while marching, which is the chief feature of life in this part of the Himalayas. However, the influence of cultural contact of the Bhot region with the people of the plains has already made its appearance.

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FIG. 1 Typical topography of Garhwal-Bhot Himalaya.



FIG. 2. A typical summer house—base of Tibetan trade.
(At Harsil-Bagori in Janhavi-Bhagirathi Valley.)



FIG. 3. Churning salted and buttered tea in a *dhomo*.



FIG. 4. Women's dress in the Mana Valley.



FIG. 5. Carding wool by beating with 'ringal' sticks



FIG. 6. Woman weaving woollen cloth with a crude type of handloom.



FIG. 7. Inscriptions on stone-slabs placed near the temple.
[‘Om Mani Padme Hum’ -Buddhist formula.]



FIG. 8. Village-temple at Harsil-Bagori.



FIG. 9. Layont of houses in the village of Mana in Saraswati Valley.



FIG. 10. A caravan of mules carrying merchandise to Tibet.
Janhavi Valley.

A LYRIST TYPE COPPER COIN

By BRATINDRA NATH MUKHERJEE

In the collection of Mr. S. K. Saraswati of the Calcutta University, there is a copper coin which can invoke a lot of interest among numismatists. This coin is published here with the kind permission of its owner. It can be described as follows :

Copper, round, weight 3.343 gm.

Obverse : King seated (probably on a couch), playing on lyre, wearing close-fitting coat and trousers, bangles, ear-rings and necklace; border of dots; fragmentary legend in Gupta character on the side of the field just before the left knee of the king . . . Nebūja.

Reverse : Goddess (Lakshmi) seated facing on lotus, nimbate, wearing girdle, bangles and necklace, holding lotus and fillet respectively in her right and left hands; border of dots; fragmentary legend in Gupta character . . . Janama.

Unfortunately, the provenance of this coin, which has been bought from a dealer, is not known. The palaeography of the fragmentary legends, however, clearly indicates that it was issued in the Gupta period or slightly after. Both the obverse and reverse devices have close similarities with certain types of Gupta gold coins. The fabric and execution of the devices support its attribution to the Gupta period.

It is a well-known fact that of the Gupta monarchs only two or three minted gold pieces of the lyrist type. They are Samudragupta¹ and Kumāragupta I.² As the legends do not help us here regarding identification of the issuer, it may be ascribed to either of these kings with almost the same amount of possibilities. If Samudragupta is taken to be the king concerned, great importance should be attached to our coin. For, in that case, Samudragupta should be considered to have been the originator of the Gupta copper series, a fact which is otherwise unknown.³ On the other hand,

¹ Allan, *Catalogue of the Coins of the Gupta Dynasties and of Sasanka, King of Gauda*, Pl. V, 1-8; Altekar, *Catalogue of the Gupta Gold Coins in the Bayana Hoard*, Pl. VI, 3-8; and Altekar, *Coinage of the Gupta Empire*, Pl. III, 15-17.

² Altekar, *Catalogue of the Gupta Gold Coins in the Bayana Hoard*, Pl. XXI, 4 and 5; and Altekar, *Coinage of the Gupta Empire*, Pl. XIV, 5. Chandragupta II might also have issued some coins of this type. In the pages of the *Progress Report of the Archaeological Survey of India, Western Circle, 1916-17*, a gold coin has been described as follows (pp. 2, 5 and 50) :

Obverse : King seated on a high-backed couch, with one foot hanging; wearing waist cloth; hand to left touching lyre or feeding some animal; legend—Paramabhāgavata Mahā . . .

Reverse : Figure of Lakshmi seated on a footstool, with a seat over it; holds uncertain object in hand; to left crescent; legend—Vikramāditya(h).

If the King really plays on lyre and if the legends have been read correctly, then this coin might have been an issue of Chandragupta II. But as no photo of this coin has been published, the reading and descriptions cannot be verified. Hence the case of this coin has not been considered here.

³ Prof. R. D. Banerjee, however, states (in his *Age of the Imperial Guptas*, p. 24) that two copper coins have been found near Katwa in the Burdwan District of Bengal (now West Bengal), which bear on the obverse a figure of Garuda on the top and the name 'Samudra' in one line at the bottom. The reverse sides of both the coins are, according to Banerjee, quite illegible. But as these coins are not traceable, nor any reproduction of them is available, we cannot be sure whether they are genuine or forged issues.

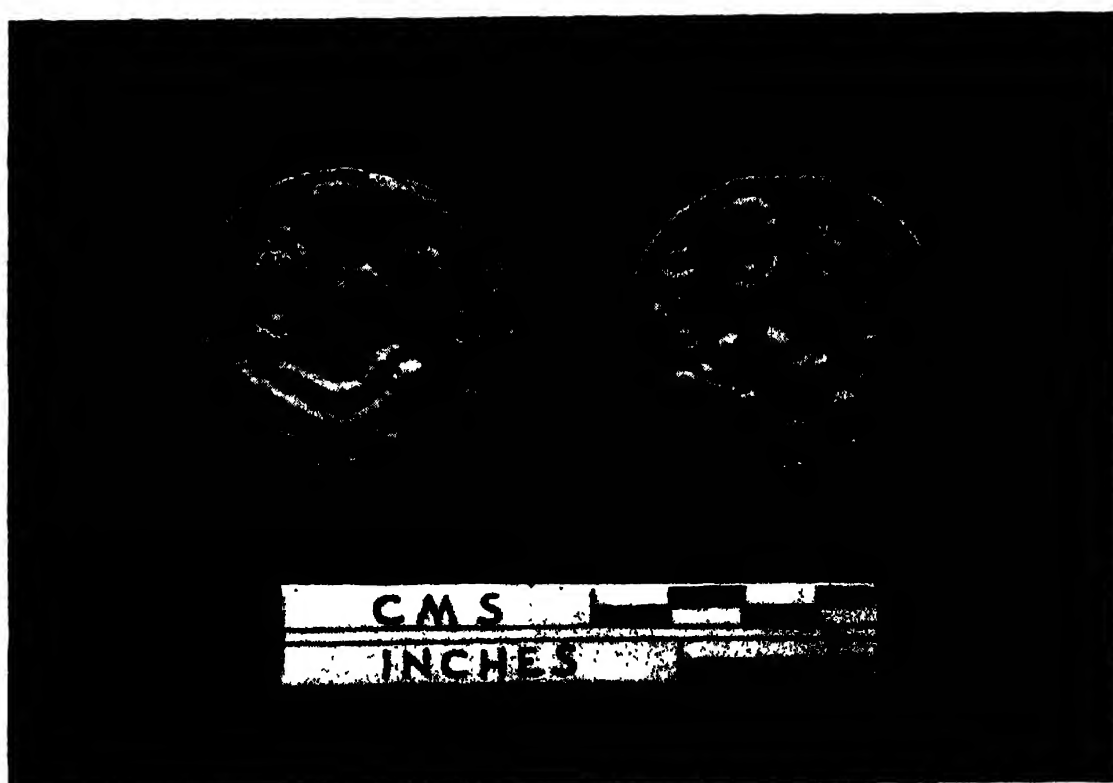
if the piece is taken to have been issued by Kumāragupta I, it should be considered to be a new type of copper coins of the said king. It seems that here Kumāragupta I may possibly have a little better claim than his illustrious grandfather. For the reverse type (goddess seated on lotus), which occurs on our coin, is known to have appeared on the Gupta gold issues for the first time during the reign of Chandragupta II, the son of Samudragupta and the father of Kumāragupta.

It should, however, be noted here that there is a little difference between the obverse and reverse devices of our coin and those of 'Lyrist Type' gold coins of Samudragupta and Kumāragupta I. In latter cases the king on the obverse is seated to left and goddess on the reverse is seated to left on a wicker stool.

A third suggestion regarding the identification of the issuer of our coin may also be offered. We know that the Gupta coins were imitated during and after the Gupta period.¹ It is reasonable to hold that our piece was minted by a chief (having the name Nebūja occurring on the obverse or Janama appearing on the reverse?), pretending independence. Nor is it altogether impossible that the coin concerned was issued in imitation of the Lyrist Type of Gupta gold coins during that period by a rich private individual, probably a Banker.

Due to lack of definite data, we are not in a position to choose finally anyone of these suggested identifications. There is, however, no denying the fact that our coin is a unique one, having no parallel in the whole range of Indian numismatics.

¹ Cunningham, *Archaeological Survey Report*, Vol. IX, Pl. V, 16; Rapson, *Indian Coins*, p. 29; *Journal of the Asiatic Society of Bengal*, 1894, p. 195, Pl. VI, 15; *Numismatic Supplement*, Vol. XXXVII, Article No. 239; Vol. XXXIX, Article No. 249; and Altekar, *Coinage of the Gupta Empire*, p. 317ff.



ICONOGRAPHIC NOTES

By DEBALA MITRA

A. AN IMAGE OF MAHĀMĀYŪRĪ IN THE NALANDA MUSEUM

In the Archaeological Museum at Nalanda is an image (ht. 4½ in.; Reg. No. 00051) which has not yet been identified.¹ Elegantly bedecked in anklets, a girdle, *valayas*, armlets, a *hāra*, ear-studs and a tiara and clad in a *dhotī* and a breast-band, the four-armed female figure, with her hair arranged at the back in the form of a bun, sits in *lalitāsana* on a double-petalled lotus against which on the right side is carved a peacock (Pl. I A). With prominent *trivalī*-marks, the modelling of the figure is fairly commendable. The halo, slightly pointed at the crown, has a beaded border. The image may be ascribed to the eighth-ninth century on the basis of the palaeography of a four-lined inscription, giving the Buddhist creed,² on the back side.

The objects in the two right hands and also in the lower left of the goddess are missing. Fortunately the attribute in her upper left is intact and reveals the true character of the image. It represents undoubtedly the feathers of a peacock. This, coupled with the peacock beside the seat, leaves no room for doubt about the identity of the figure with Mahāmāyūrī, a member of the Tantric *Pañcharakshā-maṇḍala*.³ The *Sādhanamālā* describes two-,⁴ six-⁵ and eight-armed⁶ varieties of the images of this goddess, but in all the varieties she is invariably required to hold a *mayūra-pichchha* in one of her hands. The discovery of a four-armed variety, the description of which does not occur in the published *Sādhanamālā*, thus presupposes the existence of other texts, now lost.

Among the other Buddhist centres the caves at Ellora have as many as four (if not five) two-armed reliefs of this *vidyā-rājñī*. Attention to the one carved in Cave 6 has already been drawn by Dr. J. N. Banerjea who has rightly taken it as the personification of the *Mahāmāyūrī* text, the recitation of this Tantric text being regarded as a protective charm against snake-poison.⁷ In China, the text was so popular that it was four times translated into Chinese between the fourth and eighth centuries A.D. The images are fairly prolific in that country and also Tibet.⁸

The Ellora figure in question (Pl. I B) is bedecked in anklets, a jewelled girdle, bangles, armlets, two types of necklaces, large ear-studs

¹ In A. Ghosh's *Guide to Nalanda* (Delhi, 1950), pp. 31f., it is described as follows : 'a four-armed female figure with a peacock (?) at the left end of the pedestal (No. 1A-305); as the symbols are mutilated it is difficult to propose any identification'.

² *Ye dharmā hetu-prabhavā hetum teshāṃ Tathāgato hy-avadat teshāṃ cha yo hirodha evarṇ vādi Mahā-śramaṇaḥ.*

³ B. Bhattacharyya, *The Indian Buddhist Iconography* (Calcutta, 1958), pp. 228, 232, 234 and 305f. The only illustration of Mahāmāyūrī given by him is taken from a manuscript of the *Pañcharakshā* in the collection of Dr. Evans Wentz.

⁴ As a companion of Sitatārā and Mahāśrī Tārā.

⁵ Emanation of Amoghasiddhi.

⁶ As a *Pañcharakshā* goddess.

⁷ J. N. Banerjea, 'Some Early Literary and Archaeological Data about Tantricism', *Proceedings of the Sixteenth Session of the Indian History Congress, 1953* (Calcutta, 1955), pp. 28ff.

⁸ B. Bhattacharyya, *op. cit.*, p. 234.

and a *jaṭā-mukuta*. It stands in *samapada* on a double-petalled lotus with an oval-shaped object (*ratna-ghaṭa*?) in its left hand. Though the right forearm is now missing, the attribute in the right hand was undoubtedly the feather of a peacock, the major portion of which is fortunately preserved above the right shoulder of the goddess. On her left side is a female *chaurī*-bearer holding in her left hand the branch of a tree, while on her right is a fan-tailed peacock on a pedestal immediately below which is a monk, seated on a raised seat, reading a manuscript, no doubt the *Mahāmāyūrī* text, placed on a sort of book-rest. On either side of her head is a chubby flying *gaṇa*, one carrying flowers and the other a garland. Over the top of the halo around the head is a lotus hanging from the junction of two arches. These arches issue from the mouths of *makaras*, the latter resting on pilasters. Stylistic considerations of the reliefs of this cave in conjunction with architectural features seem to indicate for this cave a date not earlier than the seventh century A.D.

A close replica of this relief is carved on the right wall of the pillared porch in front of the sanctum of Cave 8. The treatment is less ornate, but more elegant and effective. The attitude of the main figure (Pl. II A) is identical, but the modelling is more sensitive. The female *chaurī*-bearer has either a lotus-bud or a blue lotus in her left hand. The peacock, perched on a rocky ground, looks at the goddess; the monk below is pre-occupied with the *Mahāmāyūrī* text. The relief may be slightly earlier than the one at Cave 6.

The third relief (Pl. II B), later than these two, is on the back wall of the porch to the left of the door leading to the right side-chapel of Cave 10 (*chaitya*-cave). The execution is definitely crude. The arrangement of the attributes is the same, but the goddess, unattended, sits in *lalitāsana* on a double-petalled lotus placed above a peacock. Her hanging right foot rests on a smaller lotus.

The fourth relief occurs on the back wall of the antechamber, in the third storey of Cave 12, one of the latest Buddhist excavations at Ellora. On the back and side walls of the antechamber are marshalled twelve goddesses, each seated in *lalitāsana* on a double-petalled lotus, the stem of which is held by *nāgas*. The second figure (Pl. III A) on the back wall to the right of the door is Mahāmāyūrī, bejewelled in a necklace, ear-rings, an *upavīta* (sacred thread), bracelets and a *mukuta*, with a cushion behind her back. Her right hand is in the attitude of bestowing boon (*varada*), and the left holds the feather of a peacock. Below her lotus-seat is the peacock, facing.

Among the scores of reliefs of deities of Buddhist pantheon on the walls of the hall of the third storey of Cave 11 is a female seated in *lalitāsana* on a *viśvapadma* carrying a roundish object in her right hand. The object in her left hand seems to be the feather of a peacock, but it is not very distinct. The peacock is also absent.

B. BAHURŪPIṆĪ

In an article entitled 'Parents of the Tirthaṅkaras' (published in the *Bulletin of the Prince of Wales Museum of Western India*, 1955-57, No. 5, pp. 24-32) Dr. Umakant P. Shah has drawn our attention to a group of three sculptures where a lady is shown in a recumbent pose on a cot below the seat of a *tirthaṅkara*. The writer has identified her with the mother of the *jina* depicted over her.

Recently I had an occasion of examining two of these sculptures, viz. the one enshrined as the principal deity in the main sanctum of the old

temple-complex of the twentyfour *tīrthaṅkaras* on the Vaibhāra hill at Rajgir and the other in the P. C. Nahar Collection of Calcutta. Though the findspot of the second specimen is not recorded, it is known to Shri Bijoy Singh Nahar, son of the late P. C. Nahar, to have been obtained from somewhere in Bengal. A third fragmentary sculpture discovered at Rajghāt (Vārāṇasī) and now in the Asutosh Museum of Fine Art, University of Calcutta, shows a lying female below the pedestal of a *lāñchhana*-less *jina* figure, the upper part of which is missing. Though the *jina* cannot be identified, there is little doubt that the sculpture belongs to the same group.

In the first specimen (Pl. III B), which is illustrated in the article referred to above and is of about the ninth century A.D., the lady is depicted singly, while in the latter (ht. 17½"), of about eighth century, she has an attendant pressing her feet (Pl. IV A). The figure, below the seat of which each of these ladies is reclining, no doubt represents Muni Suvrata,¹ the twentieth *tīrthaṅkara*, as a tiny tortoise, his cognizance, is depicted on the seat. The cognizance immediately to the left of the wheel of the Vaibhāra specimen is too small to be readily noticed; the relief is so low that it is almost invisible in the photograph published here.

The mother of a *tīrthaṅkara*, whenever she is depicted as lying on a cot, has either a child by her side or the auspicious objects dreamt by her on the eve of the conception. The absence in the sculpture of a child and any auspicious object connected with the dream, coupled with the inferior position of the reclining figures below the seat of the *jina*, precludes the possibility of their identification with the mother of Muni Suvrata.

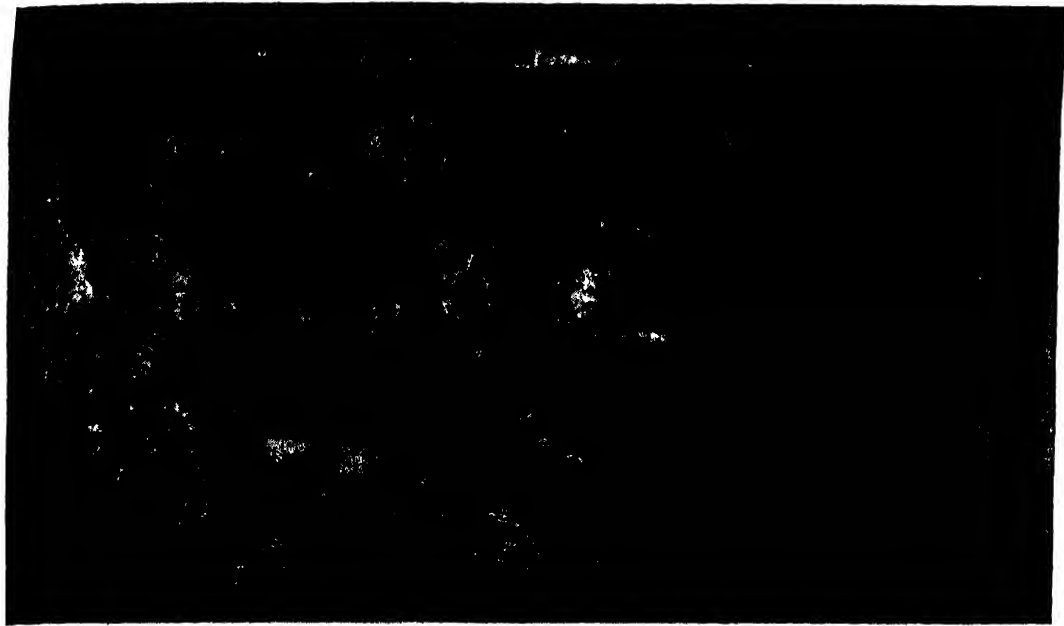
A welcome light is thrown on their identification by a relief in one of the caves of Khandagiri near Bhubaneswar (Orissa). On the three walls of the cave in question, locally known as Bārabhuji, are carved figures of twentyfour *tīrthaṅkaras*, below each of which is the figure of the respective *śāsanadevī* in a separate compartment. All the *śāsanadevīs* are seated with the exception of Bahurūpiṇī (the *śāsanadevī* of Muni Suvrata), who is shown as lying on a bed attended by three figures, one of which is fanning her (Pl. IV B).² As in the specimen in the Nahar Collection, there is a water-pot below the cot.

The reliefs leave no room for doubt about the existence, at least in Uttar Pradesh, Bihar, Orissa and Bengal, of an iconographic canon requiring Bahurūpiṇī to be shown in a reclining pose.³

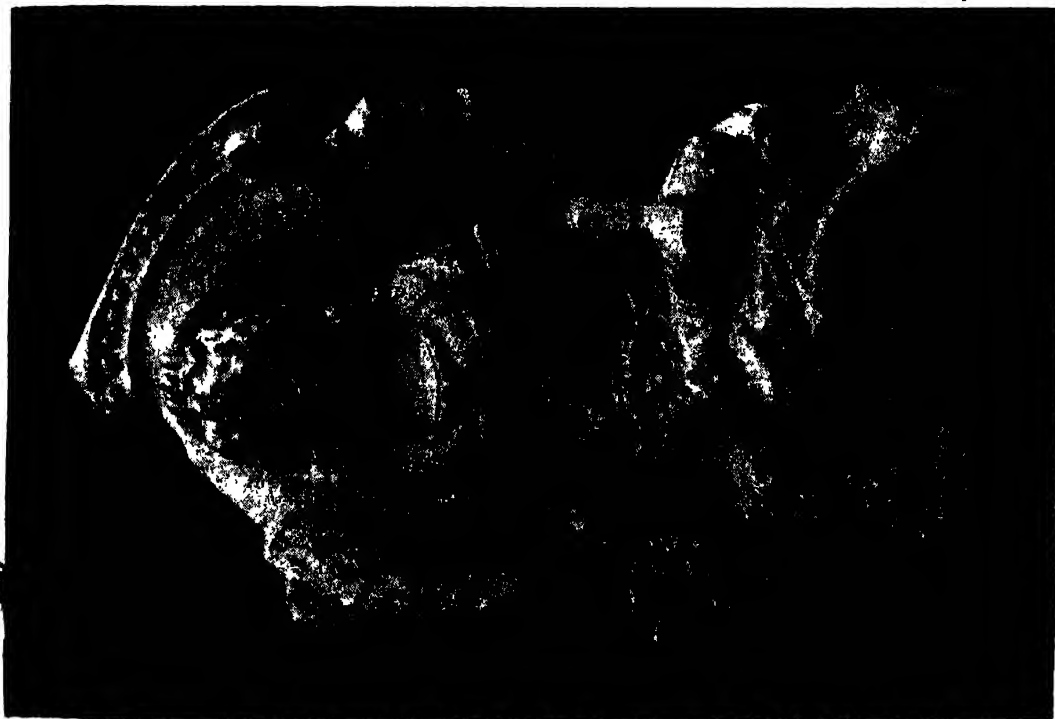
¹ He occupies the position of the *mūla-nāyaka* in the central shrine; his special sanctity is due to Rajgir being his birth-place. The rest of the *tīrthaṅkaras* were originally accommodated in the twentythree cells arranged on four sides of the quadrangular courtyard around the central shrine.

² Debala Mitra, 'Śāsanadevīs in the Khandagiri Caves', to be published in *Journ. Asiatic Soc.*

³ The photographs published here are the copyright of the Department of Archaeology, Government of India.



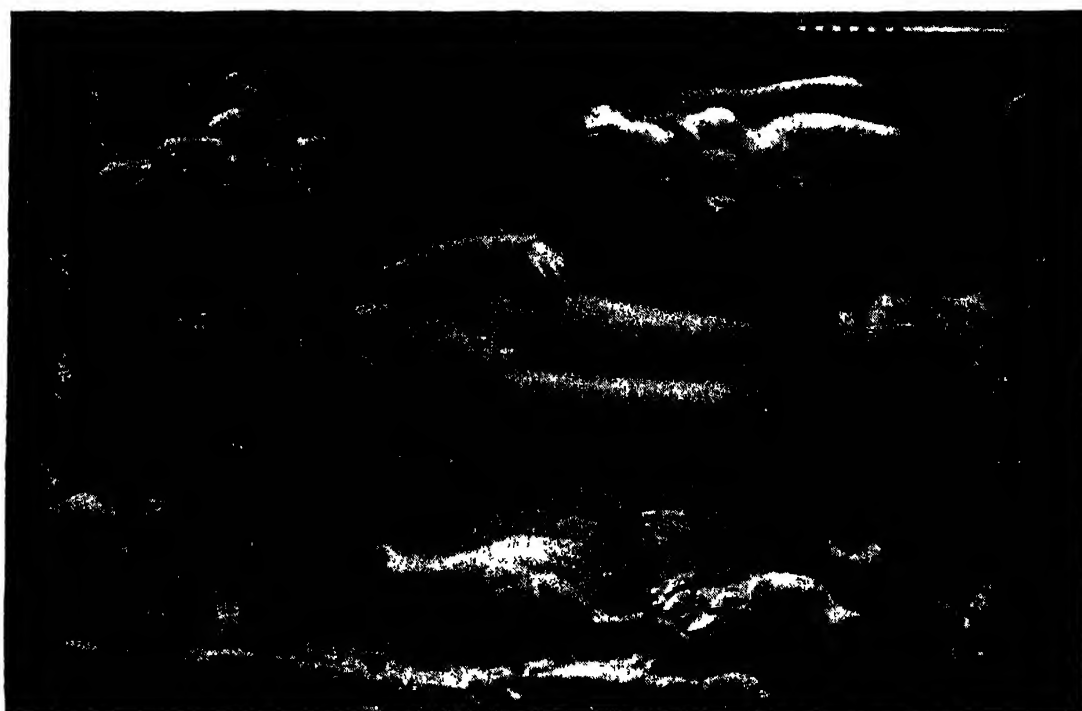
B. Mahāmāyūri, Cave 6, Ellora



A. Mahāmāyūri, Nalanda Museum



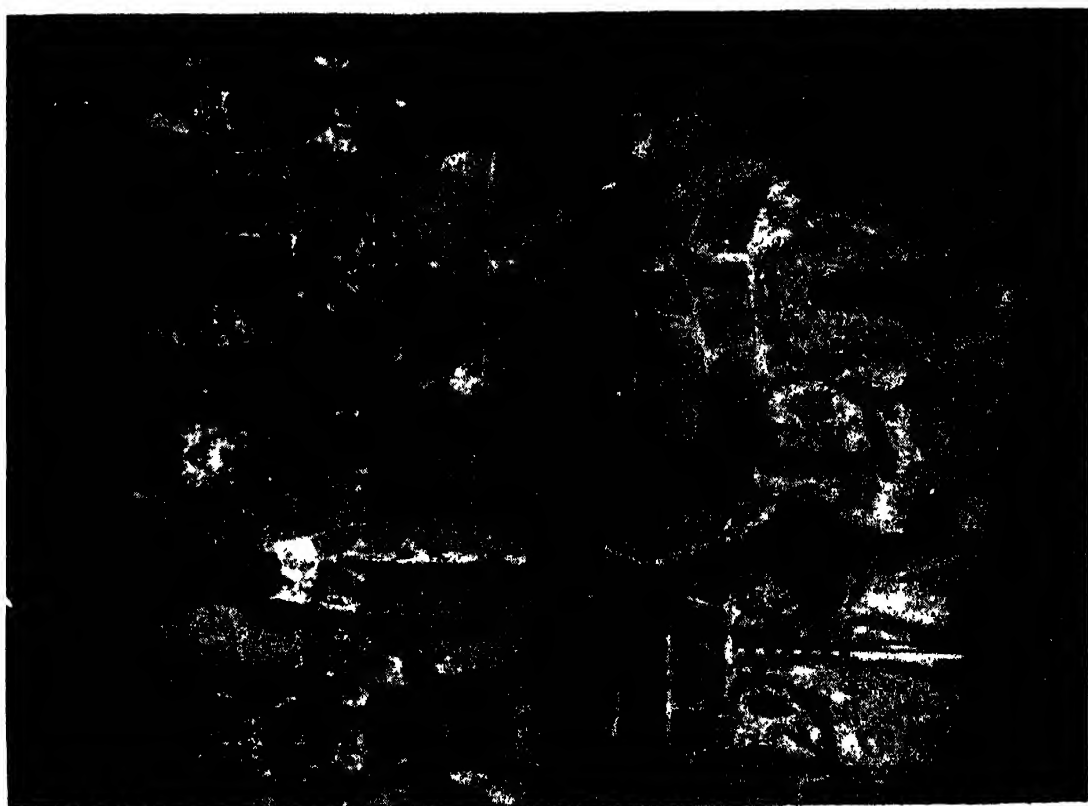
B. Mahāmāyūrī, Cave 10, Ellora



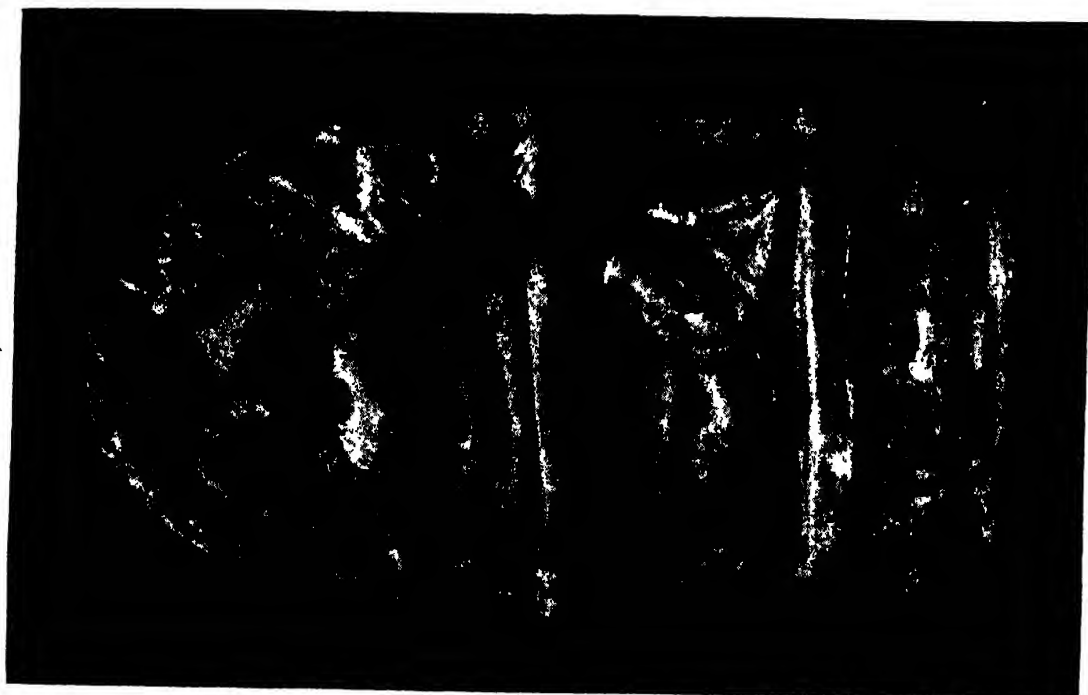
A. Mahāmāyūrī, Cave 8, Ellora



B. Muni Suvrata with Bahurūpīnī, Raḡgir



A. Mahāmāyūrī (centre), Cave 12, Ellora (left)



A. Muni Suvrata with Bahurūṇī
(Nahar Collection)



B. Muni Suvrata (left), Naminātha and Neminātha with their
śāsqandevīs, Khandagiri

TWO SCULPTURES OF ŚIVA AS LINGIN FROM THE KAILĀSA TEMPLE AT ELLORA

By R. SEN GUPTA

While approaching towards the Kailāsa temple at Ellora a visitor's eyes, after wandering along the sculptured screen walls flanking the *gopuram*, are naturally attracted to and fixed on the interesting panel of Umā-Maheśvara (Fig. 1) carved on the western face of the *Śāla-Śikhara*. The panel is so arranged in the semicircular opening of the *śāla* that Śiva with Pārvatī sitting on his lap at the centre is surrounded by dwarfs in different attitudes on brackets supporting the curvilinear roof, and below, in front, is the couchant Nandī. Of particular interest in the panel is the *liṅga* which is apparently being carried by Śiva on the right shoulder and touched by his back right hand. And of the three other hands of Śiva the proper right hand is placed on his right foot on the ground, the proper left hand touches the head of Pārvatī while the back left hand carries a lotus. Pārvatī sitting on the left lap of Śiva keeps her right hand on his right foot and her left hand is touching the left *karna-kunḍala*.

Another sculpture of Śiva (Fig. 2) of the same nature has recently been noticed by the writer. This is a small image carved at the top of the *deva-koṣṭha*, on the outer face of the northern wall of the *garbhagriha* of Kailāsa. It is to some extent mutilated but enough of it remains to show clearly the *liṅga* on the left shoulder of Śiva, touched by him with his back left hand. His proper left hand is on the ground and the right hands are broken.

The Aihole panel of Umā-Maheśvara, now housed in the Prince of Wales Museum, Bombay, also depicts Śiva with the *liṅga* on his shoulder. This aspect of the sculpture was noticed for the first time by Śrī Chakravarti,¹ Curator of the Archaeological Section of the Museum. In this panel, however, the *liṅga* is on the left shoulder of Śiva and he touches it with the back left hand.

Dr. Moti Chandra has kindly drawn the attention of the writer to a fragment of a sculpture (Fig. 3) in the Bhārat Kalā Bhavan, which, unlike the panels described above, depicts the *liṅga* placed on a *padmapīṭha*, being carried on the head by a male whose broken hands on the sides of the *padmapīṭha* are still extant. Provenance of this sculpture is not known and it is said to have been identified by the late K. P. Jayaswal as the representation of a 'Bhāraśiva King'² who, according to the epigraphical records,³ used to carry a *liṅga* as a load on the shoulder. The nature of the sculptures from Aihole and Ellora, however, precludes such an identification.

¹ S. N. Chakravarti—P.W. Museum: *A Guide to the Antiquities of the Historic Period*, p. 21, pl. xa. Though the panel was published by H. Cousens in his *The Chalukyan Architecture* (pl. XVII) he did not notice the *liṅga* on Śiva's shoulder.

² Also see *A Comprehensive History of India*, K. A. Nilakanta Sastri Ed., Vol. 2, p. 258 f.n.

³ *Aśvabhāra sanniveśita Śiva liṅgodvahana*, etc. (J. F. Fleet—*Gupta Inscriptions*, pp. 236, 245).

The suggestion that readily appears to one's mind is that this type of sculptures might have some connection with a branch of Śaivism, which is known as Viraśaivism, the followers of which carry the *līṅga*. It is generally held that Viraśaivism came into existence only in the twelfth century A.D. with Basava, minister of the king Vijjala or Vijjana (A.D. 1157–1167) of Kalyāṇa, who is credited with originating it. On the strength of available evidence the question of any likely connection between Viraśaivism and these sculptures will be discussed in this paper.

While discussing about Viraśaivism R. G. Bhandarkar¹ has observed that the creed is older than the date that is generally attributed to it. He has further shown that Ārādhyas, who were of Brahmanic descent, formed a distinct sect of that name and was affiliated to Viraśaivism. According to an account in *Śaṅkaravijaya* by Anantānandagiri² an Ārādhyas sect came into conflict with Śaṅkarācārya. On the strength of this account the sect may be considered to have come into existence about the time of Śaṅkarācārya, i.e. before the ninth century A.D. Therefore, it appears that Basava in the twelfth century A.D. acted as a reformer of the older doctrine which came to be known as the Viraśaiva or Līṅgāyat sect, while a portion of the followers of the older doctrine clung to the orthodox faith, in which is to be traced the Ārādhyas sect of the present day. Based on the epigraphical records Fleet,³ however, opined that the Viraśaiva sect must have received encouragement and support, among others, of the 500 Svāmīns of Aihole who were adherents of the Vira-Banañju doctrine. To what extent this sect helped in the formation of the Viraśaiva system is yet to be decided. It may be mentioned here that the panel in the Prince of Wales Museum, already referred to above, also comes from Aihole which is significant.

Besides the Ārādhyas or Viraśaivas, still earlier, the Bhāraśivas used to carry the *līṅga* on their shoulders as mentioned in the epigraphical records of the Vākāṭakas, whose maternal ancestors were the Bhāraśivas. But at that time (fifth century A.D.) which particular branch of Śaivism, and under what name, professed such a practice cannot be ascertained. The apparent similarity between the Bhāraśivas and Viraśaivas in carrying the *līṅga*, the former on the shoulder, probably as seen in the sculptures under discussion, and the latter suspended from the shoulder tied to the thread or to a piece of cloth, is all that is evidenced.

Worshipping or revering the *līṅga* by carrying it on the person was therefore not exclusive to the Viraśaivas or Līṅgāyats alone. Śrī M. N. Deshpande⁴ feels that such an idea might have as well been influenced by the Buddhists who used to carry relics, symbols and effigies of the *Dhyānī* Buddhas. One is, however, reminded of the meaningful couplet:

Kiṭo bhramarayogena bhramaro bhavati dhruvam |
*Mānavah Śivayogena Śivo bhavati kevalam ||*⁵

which in a way explains the concept so far as it relates to a Śaiva worshipper carrying the *līṅga* regarded as the symbol of the Supreme Being.

¹ *Collected Works of Śrī R. G. Bhandarkar*, Vol. IV, p. 190.

² *Ibid.*, Vol. IV, p. 199 f.n.

³ J. F. Fleet—*Epigraphia Indica*, Vol. V, p. 244.

⁴ Communicated to the writer in a personal discussion.

⁵ 'Just as the larva which associates with the bee, itself in the end becomes a bee, so the man who realizes unity with Śiva through Śiva-yoga himself becomes one with Śiva' (Alain Danielou—*Yoga*, pp. 96, 160).

And truly, all emerging out of Him at the journey's end is to re-unite with Him. It is with such a background that Śiva also came to be depicted in his anthropomorphic form as giving prominence to his symbolic form, so that the idea of carrying or revering the *linga* is upheld. Other instances wherein the *linga* is thus glorified are the Guddimallam *linga* and the *Lingodbhavamūrti*. In the latter, in particular, is discernible the echo of the earlier conceptions in such passages from the Vedas as quoted by Rao,¹ 'where Skambha, generating, brought Purāṇapurusha into existence' and 'Skambha in the beginning shed forth that gold (*hiranya*, out of which Hiranyagarbha arose) in the midst of the world', etc. Skambha seems to have been identified later by the Śaivas with the *linga* and it appears that 'one of the functions of Skambha was to beget Hiranyagarbha or Purāṇapurusha, the god of reproduction'. (One of the functions of Śiva is also reproduction). In the same vein the *Linga-purāṇa*² too states that 'Pradhāna (nature) is called the *Linga* and Parameśvara is called the *Lingin* (the sustainer of the *Linga*)'. Parameśvara is one of the epithets of Śiva. Śiva's role as the *Lingin* in the material universe is therefore to be regarded as exemplary for the common people to emulate, the same way he is portrayed as Mahāyogī, 'teaching men by his own example the power to be acquired by mortification of the body, suppression of the passions and abstract contemplation, as leading to the loftiest spiritual knowledge and ultimately to union with the Great Spirit of the universe' which is visualized as Skambha or the *Linga*. The same idea appears to have worked in depicting Viṣṇu³ with six arms carrying a *linga* in the proper left hand with the right hand kept above it, as if worshipping in the *Lingāyat* way, while the other four hands carry as usual *śankha*, *chakra*, *gadā* and *padma* respectively. The sculpture is to be found in the Siddheśvara temple at Haveri.

The image of Viṭhobā in the famous temple of Pandharpur is said to carry a *linga* on the head. This has been mentioned by the celebrated Maharashtrian saint Jñānadeva in his *Abhaṅgas*, as also indicated by his elder brother Nivṛtтинātha, Tukārām and later by Rāmadāsa. Professor Ranade quoting the relevant portion says, 'This is as much as to say that Śiva who was the greatest devotee of Viṣṇu was himself held aloft on his head by Viṣṇu in the form of Viṭṭhala.'⁴ Although the nature of the object on Viṭhobā's head is disputed,⁵ it is significant that several Maharashtrian saints have mentioned or indicated the object to be a *linga*. Among other deities Devī is often sculptured as carrying the *linga* in one of her hands. In the subsidiary excavation, known as Lankeśvara attached to the Kailāsa temple at Ellora, can be seen such a representation. According to the *Chandīmāhātmya* Mahālakṣmī is required to carry the *linga* :

Mātulingam gadām kheṭam pānapātrañcha bibhratī |

*Nāgam lingañcha yoniñcha bibhratī nṛipa mūrdhaṇi ||*⁶

The loose sculpture in the Siddheśvara temple at Haveri answers to such a description and is seen to carry the *linga* on the *yonipatṭa* with a snake

¹ T. A. G. Rao—*Elements of Hindu Iconography*, Vol. II, Part I, pp. 56-59.

² *Ibid.*, p. 59.

³ Cousens—*Chalukyan Architecture*, Pl. LXXXI.

⁴ R. D. Ranade—*Mysticism in Maharashtra*, p. 41.

⁵ See G. H. Khare's *Śrī Viṭṭhal āṇi Pāndharpur* (in Marathi), pp. 16-25, M. M.

P. V. Kane's *History of Dharmasāstra*, Vol. IV, pp. 718-19, etc.

⁶ Swami Jagadisvarananda—*Śrī Śrī Chandī* (in Bengali), p. 367.

spreading its hood over the *liṅga*. The medieval sculpture of Devī from Pālikherā Well II, now in the Mathura Museum (No. 882), however, is seen supporting a *liṅga* with the extra pair of hands on the head.¹

Mention must be made here of a relevant sculptural panel (Fig. 4) in which Śiva and Pārvatī both hold the *liṅga*. The panel is in the north side of the *prākāra*² of the Kailāsa. In this panel sitting side by side with Pārvatī Śiva carries the *liṅga* in the left hand and his right hand is in *abhaya* while Pārvatī touches it with her right hand. According to the Viraśaivas in the *dīkṣā* the *gurū* hands over the *liṅga* to the initiated with his left hand and they claim their preceptor to have received the *liṅga* from a person no less than Śiva himself. Further, the recipient of the *liṅga* has to be very careful as its loss is thought to be equivalent to spiritual death. In this connection the allusions made in the *paurāṇic* story of Rāvaṇa's reception of the *liṅga* and its loss may be considered *vis-à-vis* the precepts mentioned above. The account states that pleased with the devotion of Rāvaṇa, Śiva was obliged to give him the *liṅga* with the proviso that he will always carry it and will never put it on the ground. Rāvaṇa's prowess had already proved to be a matter of concern to the gods and with the favour shown to him by Śiva, they were all alarmed and decided to dispossess him of the *liṅga* which would otherwise make him invincible. However, Rāvaṇa after receiving the *liṅga* proceeded towards his home. After going some distance he felt the necessity of easing himself but the *liṅga* was to be borne by somebody. In the nick of time Viṣṇu appeared there in the guise of a brahmin who was requested to hold the *liṅga* which was agreed upon. When Rāvaṇa was busy in the fields, Viṣṇu putting the *liṅga* down on the ground himself vanished. Rāvaṇa returned only to see the *liṅga* implanted on the ground which would not budge and was doomed. The *liṅga* enshrined in the famous temple of Vaidyanāth or Baijnāth (in Bihar), known as Mahādeo Rāvaṇeśvara, is claimed by the people there to be the elusive *liṅga* and the story³ mentioned above is related in details. There are yet other places in the South associated with this account. Mahābalīpuram is said to have been named after the mighty *liṅga* which defeated the potency of Rāvaṇa. The *liṅga* known as Mahābaleśvara enshrined in the famous temple of that name at Gokarna is also claimed to be the holy *liṅga*. The story narrated in relation to the *liṅga*, although the same as above in essence, is little different. It says:⁴ To fulfil the desire of his mother, to worship 100,000,000 *liṅgas* Rāvaṇa was wandering in search of the *liṅgas* whereupon he was told that worship of the *ātma-liṅga* with a *bilvapatra* every day bestows upon the worshipper the benefit of worshipping 100,000,000 *liṅgas*. Rāvaṇa by propitiation obtained the *ātma-liṅga*, which was worn round the neck of Śiva, on the condition that he would always carry it and not put it on the ground. On his way home, in the evening he wanted to say his prayers but was confronted with the problem of safe custody of the *liṅga*. At the opportune moment Ganeśa appeared on the scene in the guise of a cowherd and on Rāvaṇa's request agreed to carry it provided he would take it back from the cowherd on his calling Rāvaṇa up to three times. Rāvaṇa hastened towards the river but the cunning

¹ V. S. Agrawala—*A Cat. of the Brahmanical Images in the Mathura Art*, p. 53.

² Although the *prākāra* forms a part of the original conception of the Kailāsa temple, the style and execution of the sculptures point them to a later date than the eighth century A.D.

³ J. D. Begler—*A.S.I. Rep.*, Vol. VIII, pp. 143–45.

⁴ *Gazetteer of the Bombay Presidency*, Vol. XV, Part II, p. 290 f.n.

cowherd called after him three times so fast that Rāvaṇa could not even turn his back. Gaṇeśa then placing the *liṅga* on the ground vanished, wherein it was implanted. Rāvaṇa returning to the spot tried with all his might to dislodge the *liṅga* in vain and exclaimed that the *liṅga* was very powerful whereupon it attained the name Mahābaleśvara. A sculptured panel in the south side of *prākāra* of the Kailāsa shows Rāvaṇa trying with all his might, with the cheeks swollen and eyes bulging due to holding of breath, to enable him to apply full force, to dislodge the *liṅga* that is planted on the ground.

Anyway, from the above-mentioned versions of the account it emerges that the *liṅga* was intended to be carried by Rāvaṇa on his person, most probably an ancient custom practised by a section of the Śaivas and alluded to in the episode, which is further corroborated by the Vākāṭaka inscriptions referring to the Bhāraśivas carrying the *liṅga* on their shoulders and the Bhārat Kalā Bhavan sculpture. Throughout the centuries the custom was kept alive, as portrayed in the sculptured panels from Aihole and Ellora and probably by the earlier Ārādhyā sect which is mentioned in the *Śaṅkaraviṇaya* to be finally popularized by Basava among the followers of the Liṅgāyat system.

The purport of the panel with Śiva and Pārvatī holding the *liṅga* perhaps is to be explained in the light of the above discussions as handing over the *liṅga* to the initiated to be carried on the person. In that case it is to be connected with the panel on the *Śāla-Śikhara* of the *gopuram*. But at this stage it is still immature to say whether the depiction of the panel at such a prominent place, as on the *gopuram*, has an implication or it was just a matter of course that among so many other themes this particular theme of Śiva as *Lingin* also happened to be depicted there. Further researches can only throw light on it.



FIG. 2. Śiva as *Liṅgin* from Kailāsa temple, Ellora.



FIG. 1. Śiva as *Liṅgin* with Pārvati from Kailāsa temple, Ellora.



FIG. 3. So-called 'Bhāraśiva King' carrying
the *linga*.

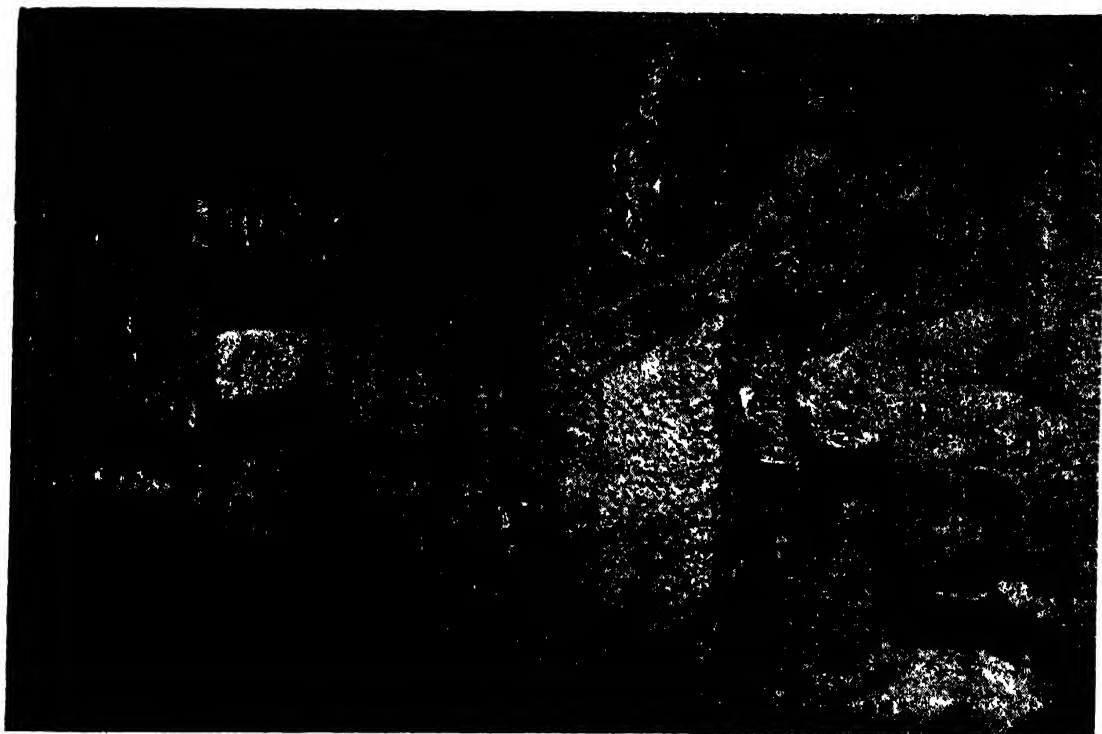


FIG. 4. Śiva and Pārvatī with the *linga* from Kailāsa,
Ellora.

THE ERAS IN NEPAL¹

By R. C. MAJUMDAR

Two different eras were in use in Nepal, before the current Newari *Samvat*, starting in A.D. 879, came into use. The earlier one was first used in an inscription of Mānadeva dated in the year 386,² and was continuously in use during the reigns of Vasantadeva (428, 435, 454), Rāmadeva (469), and Gaṇadeva (482, 489). Four records issued under the joint names of Śivadeva and Aṁśuvarman bear the dates 517, 518, 519, and 520 of the same era.³ The last known record in this series is dated 535; the name of the king is missing but it bears the name of Rājaputra Vikramasena as *Dūtaka*.⁴

Next we find a series of inscriptions issued by Aṁśuvarman alone bearing dates 30, 32, 34, 39, and another which has been doubtfully read as 45, the figure for 40 being alone certain.⁵ The reckoning in this era was continued by the successors of Aṁśuvarman such as Jishnugupta (48, 49, 55, 59), Vishnugupta (64, 65), and Narendradeva, whose earliest inscription is dated 69 and the latest in 103.⁶

The epoch of these two eras has formed the subject of a keen and prolonged controversy among scholars. The older one has been assumed to be Vikrama Era, Śaka Era, Gupta Era, or a special era beginning in A.D. 110 by different scholars.⁷ The later one is generally referred to the Harsha Era, but S. Lévi regarded it as a special era beginning in A.D. 595.⁸ We may refer to these two eras as No. I and No. II.

The discovery of a large number of new inscriptions⁹ in recent years has thrown new light on this matter, and it is possible now to arrive at a more satisfactory conclusion regarding the epoch of these two eras.

There is authentic Chinese evidence to the effect that a Chinese embassy, which visited Magadha in A.D. 643, passed through Nepal and was received by its king Narendradeva, either on its way to or back from Magadha.¹⁰ It is, therefore, certain that Narendradeva occupied the throne of Nepal within a year or two of A.D. 643. As noted above, the earliest known date of Narendradeva is the year 69 of the Era No. II, and his predecessor was on the throne in the year 65. The epoch of this era must therefore fall before A.D. 578, with a margin of error of one or two years on either side. For if the Era No. II began at a later date, then Vishnugupta, and not Narendradeva, would have been on the throne of

¹ This article is chiefly based on the *Nepalese Inscriptions in Gupta Characters* by Raniero Gnoli (Roma, 1956). This is the latest compilation of Nepalese inscriptions and includes a large number of inscriptions hitherto unpublished. In the following footnotes the Roman figure refers to the number of inscriptions in this book.

² No. I.

³ Nos. XII-XXXI.

⁴ No. XL.

⁵ Nos. XXXV-XXXIX, XLI, XLVIII.

⁶ Nos. L, LI, LV, LVI, LXI, LXII, LXV-LXXIII.

⁷ For these and other views on this subject, cf. *The History and Culture of the Indian People*, Vol. III, p. 83.

⁸ *Ibid.*, 85-86.

⁹ These have been published by R. Gnoli. See f.n. 1.

¹⁰ S. Lévi: *Le Nepal*, II, 164. *The History and Culture of the Indian People*, Vol. III, p. 137, f.n. 1.

Nepal in A.D. 643. It is thus definitely proved that the Era No. II cannot be regarded either as Harsha Era or a special era beginning in A.D. 595.

As mentioned above, Rājaputra Vikramasena was the *Dūtaka* of an inscription dated in the year 535 of Era No. I. He was also the *Dūtaka* of two records¹ dated in 32 and 34 of the Era No. II, but another *Dūtaka* takes his place in a record of the year 39.² Thus the year 535 of the Era No. I must closely correspond to the years 32 and 34 of the Era No. II. In other words, there was a difference, roughly speaking, of 500 years between the epochs of the Nepalese Eras Nos. I and II. If we remember that the Era No. II must have started near about A.D. 578, i.e. the year 500 of the Śaka Era, the natural presumption arises that the Era No. I was really the Śaka Era.

It must be remembered that the first instance of the use of the Era No. I in Nepal is met with nearly four hundred years after it was founded. No era, other than the traditional Śaka and Vikrama Eras, was likely to have been in use for 400 years unless it was founded by a powerful dynasty whose name and fame continued for such a length of time. It is difficult to believe that there was such a powerful dynasty in Nepal and yet no record or other evidence of its existence before the year 386 has come to light. The chances, therefore, are that when the rulers of Nepal began to issue records they used a current and well-known era. Now as the era started in or not long before A.D. 78 it cannot be either the Vikrama or the Gupta Era. The Śaka Era is the only one which suits the circumstance and fits in with all the known facts.

We may, therefore, easily presume that the Nepalese rulers and people first used the Śaka Era, and when it completed five hundred years, and Amśuvarman, of a new dynasty, came into power, he signalized his authority by dropping the hundredth year of the Śaka Era, so as to make it appear like a new era of his own.

As mentioned above, the current era in Nepal started in A.D. 879, only one year after 800 Śaka Era. If we allow for the difference of one year as not unlikely to happen on account of the confusion between current and expired years, we may suppose that this era was also really the Śaka Era with eight hundreds omitted.³ It would thus appear that the Śaka Era has been in continuous use in Nepal, but at the end of its five hundredth, and again of the eight hundredth year, the figure for hundreds was dropped, and the reckoning was commenced again as from year 1, 2, etc.

Whatever we might think of this hypothesis, it is now definitely proved that the era used by Amśuvarman and his successors must have begun some time before A.D. 580. It cannot be long before that date, for Amśuvarman, who must have died between the years 40 and 48 of the era, is referred to by Hiuen Tsang, who visited the regions near Nepal in A.D. 637, as a king recently dead.

Incidentally, it may be mentioned that the newly discovered inscriptions of Nepal and the determination of the epoch of the Era No. II remove the difficulties so far experienced about adjusting the dates of Narendradeva with those of his son Śivadeva and grandson Jayadeva, whose known dates were, respectively, 119 and 157. Referred to the Harsha Era, these would be equivalent to A.D. 725 and 763, and assuming the use of the Tibetan Era of A.D. 595, they would correspond to A.D. 714 and 752.

¹ Nos. XXXVII, XXXIX.

² No. XLI.

³ S. Lévi actually made this suggestion (*Le Nepal*, II, 181-82).

In either case there was too long an interval between these dates and A.D. 643, the known date of Narendradeva. We may now arrange the dates of these kings as follows : Narendradeva, whose last known date is year 103 of the Era No. II, must have reigned till about A.D. 680. Śivadeva's known dates 109-125 would correspond to about A.D. 686 to 702, and Jayadeva's date, which is now read as 159, would correspond to A.D. 736. This seems to be quite satisfactory.

PRACTICAL METHODS FOR CONTROLLING THE WATER WEEDS IN FISHERY TANKS*

By EVA MITRA

INTRODUCTION

Hutcheson *et al.* (1936) define weed as 'a plant out of place'. It is known that overgrowth of aquatic plants is harmful to fish culture in many ways. Goor (1950) writes that in fishery tanks there are a number of weeds which act as host plants for some diseases and pests of fish. Control of such weeds is essential in pisciculture to save the fish crop from their adverse effects.

Control of weeds demands a thorough knowledge of the life history and growth requirements of the plant or plants to be controlled. Robins *et al.* (1952) write that weeds, reproducing by seeds alone, can be controlled by preventing seed production. In perennial weeds, not only setting seeds but vegetative reproduction as well requires to be eliminated. Surber (1949) observed that diversity in reproduction and propagation of submerged aquatic plants makes them difficult to control. Most of the coarse weeds are flowering plants but vegetative reproduction is also common among these weeds. The terminal buds and sections of stems bearing fragments of leaves produce new plants. A common method of propagation is through underground stems. Surber writes further that submerged weeds established in a pond have to be eliminated either by shading them out or by killing them with chemicals. Mechanical mowing of weeds gives only temporary results as the bottoms of many hatchery ponds usually remain moist enough to preserve fragments of stems in a viable condition long after the top soil appears to have dried out.

In India, water areas of various sizes are used for pisciculture. In most of them regular culture of fish is not carried on. Even though there is need for increasing the yield of fish, many water areas cannot be used for piscicultural purposes as these are overgrown with aquatic weeds. With the overgrowth of higher and lower aquatic plants, diseases and pests of fish inhabiting such areas also increase. If fish culture is to be carried out in such water areas they should first be cleared of the higher aquatic plants and then the insects and pests harbouring the water areas should be destroyed guarding against poisoning the water for fish culture.

Extensive work under controlled conditions as well as in the field has shown that there can be no universal panacea for killing weeds. Control methods have to be based on the species and on the environmental conditions. Further, it is necessary to take into consideration the season and the stage of development of the weed in order to determine the lethal dose and the best manner in which to apply the chemical. It does not however seem logical to expect that the same method of weed control will give even approximately comparable results on all weeds or under all the various climatic and soil conditions under which the same type of weed may grow.

Cockayne (1918) while working on agricultural weeds stated that control of weeds is a constant necessity in New Zealand. Of prime importance is the intensive study of the species causing damage, both from the autecological

* Part of the thesis submitted for the D.Phil. (Arts) degree of the Calcutta University. Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore.

and the synecological aspects; knowledge of its habitats, relation to soil and climate, method of dissemination, special plant and animal enemies, power of variability and actual distribution is necessary before work on weed control is taken up.

The use of chemicals for controlling weeds gained some importance during the last decade of the nineteenth century and the early part of the twentieth. A chemical suitable for killing weeds on large area must be inexpensive and easily applicable. It should be specifically poisonous to the weeds but should not render the soil sterile or unfit for the growth of crops for a long time. Audus (1953) states that environmental conditions such as the weather, nature of the soil, etc., affect the response of weeds and crops to herbicides. There is also some indication that different species respond to temperature differently, but no systematic work has been done on this point. Weaver and Rose (1946) claimed to have activated 2, 4-D compounds and MCPA in the laboratory by using ultra-violet light. Soil contains both growth inhibiting as well as growth promoting substances whose effects depend on their relative concentrations. Bartsch (1954) states that methodology of weed control varies with the nature of the problem, the geographic area, the existence of restrictive legislation, the equipment at hand and the knowledge and experience of those doing the work.

In the tropical countries it is very laborious to check the growth of the vegetation in large areas. Before any decision is taken to control the weeds of a choked up water area, it is necessary to carry out basic ecological studies on plants and animals in the particular aquatic environment. The most important for each species of aquatic plants are the variations in reproductive stages during different seasons of the year. Knowledge of this single fact alone enables the selection of the proper method. The problem of controlling excessive weed growth was restricted, till lately, to land weeds. Recently, however, the problem of controlling aquatic weeds has become very important both from the point of health of people and of the development of fisheries. There are many chemicals which can be used as aquatic herbicides. But most of these are poisonous and harmful to all lives present in the aquatic environment. It would not be advisable to use such herbicides in fishery ponds or reservoirs where fish and fish food organisms are the most important items requiring protection. Intensive work on the problem of aquatic weed control has to be carried out before some safe, cheap and easy method which can be used widely is discovered.

RECENT WORK ON THE PROBLEM

In some of the Asiatic countries, aquatic weed control has been taken up during recent years and the results obtained have been published also. Vaas (1951) worked on the biology and ecology of the plant *Eichhornia crassipes*, notably on features important from the point of damage and eradication. In experiments conducted to test the harmful effects of 2, 4-D on fish and freshwater biota in Indonesia, it was observed that it does not have any such effect at the concentrations used for weed control. Another (Anonymous, 1955), working with superphosphate on land plants, states that it is suitable for application to all crops. Cereal crops like rice, wheat and barley give additional yields when it is applied along with nitrogenous fertilizers.

The control of algae with copper sulphate is well known and has been used for many years. Sodium arsenite for long was recommended for control of submerged aquatic plants as it is very effective for killing aquatic vegetation but the chemical is very poisonous and its use has already been

restricted. In India fishery waters are also used by the public very freely and so it is most essential that non-poisonous chemicals should be used. Some new chemicals are at present being tested and others will probably be found in the future for adaptation to this type of control work.

Goor (1950) investigated the possibility of chemical weed control in field experiments with weeds and the principal food crops. He recommended chemical weed control in the rice growing areas where there is a shortage of labour and susceptible weeds predominate.

Longtin (1955) states that large areas of unexplored knowledge concerning the basic ecological relationships between plants and animals in the aquatic environment and the effects of plant control on the total environmental complex still remain to be worked out. Decisions have to be based on the limited facts known and attempts are made to keep the errors on the conservative side. He further states that aquatic plant control involves three separate and distinct phases, viz. (1) Control of submerged plants, (2) Control of emergent plants, and (3) Control of algae.

Jacobson (1956) in the North Central Weed Control Conference states that when weed control work is taken up, first of all, identification of plants is an important necessity. Before closing his speech he quoted from the *Extension Circular of the College of Agriculture* (1936, revised in 1940) considered to be the weed control bible for a number of years: 'No matter how well conceived and elaborately stated our regulatory measures, they cannot be fully and effectively considered unless public sentiment is in thorough accord with their application and enforcement.'

When work on the problem of weed control was taken up by our department it was very difficult to procure weed infested tanks in the neighbourhood of Calcutta as the water of the tanks was being used by the neighbouring residents who were afraid of the poisonous effects of chemicals. The tanks could be procured for the experiments only after full assurances to the public about the safety of lives.

Some of the methods tried for eradication of unwanted vegetation of higher aquatic plants in fishery tanks without adversely affecting the fish life or the fish food or the environment are elaborated in this article.

EXPERIMENTS CARRIED OUT UNDER LABORATORY CONDITIONS AND ALSO IN THE FIELD

In order to minimize, as far as possible, the reappearance of the unwanted vegetation, the following laboratory and field experiments were carried out.

I. BY USE OF POISONOUS CHEMICAL

The physico-chemical nature of water plays a very important role in tackling the problem of destruction, eradication, removal or control of aquatic vegetation in an open water reservoir meant for fish culture. In tackling such a problem interaction of the active constituent of the added chemical on any constituent of the medium of fish life, and also its inactivation due to low temperature, high turbidity and other allied factors are all to be taken into careful consideration. Consequently no generalization is possible with regard to the use of chemical for destroying the water plants in a particular type of water area. Effect of a chemical may not be the same in different tanks with different physico-chemical compositions of water. The effect of a chemical on vegetation also varies with different types of weeds. Banerjea and Mitra (1954) have shown that an easily available chemical like copper sulphate can be used for controlling a common, rooted and entirely

submerged, bottom aquatic weed *Ottelia alismoides*. This grows abundantly in alkaline waters of Orissa. It was found that this aquatic weed could be destroyed by 10 p.p.m. of copper sulphate when the quality of the water in the tank is slightly modified by lowering the pH to a slightly acidic condition. The method, however, will have limited applicability as the dose of copper sulphate (10 p.p.m.) is rather high and under slightly acidic condition this will evidently be very toxic to fish and other organisms serving as food of fishes. An attempt has, therefore, been made to maintain the watery medium of the tank non-lethal to fish life by adding the chemical in instalments so that the Cu^{++} ion concentration of the medium may not reach the lethal level at any particular time.

Experiments in cement cisterns were conducted with a view to finding out the ways and means of eradicating or at least controlling the annual, rooted, submerged and floating vegetation *Hydrilla verticillata* Presl., one of the most common weeds in the alkaline waters of Orissa. The chemicals used were commercial grade sulphuric acid (80% purity and sp. gr. 1.7) and commercial copper sulphate (about 98% purity).

Experiment and results

The experiments were conducted in two series. In the first series of experiments the optimal dose of copper sulphate was determined for destroying the weed under slightly acidic condition. The effect of maintaining a moderately acidic environment on these plants was also studied.

The weed, *Hydrilla verticillata*, collected from a fish nursery pond (Cuttack), was planted in five cement cisterns having approximate internal dimensions 6' \times 3' \times 3' and provided with a substratum of pond mud about 6" deep. The mud had been dried, powdered and mixed uniformly so as to ensure identical bottom soil conditions in all cisterns. Water level in each was maintained at about 2 feet. After a few weeks all five cisterns got choked with a luxuriant growth of weeds.

Cistern (1) was kept as a control (no treatment), cisterns (2), (3) and (4) were treated with commercial copper sulphate at doses 2 p.p.m., 6 p.p.m., and 10 p.p.m. respectively after lowering the pH of each to 6.0 by treatment with commercial sulphuric acid. The pH of cistern (5) was lowered to 5.0 and maintained between 5.0 and 6.0 by daily application of acid and no copper sulphate was used here. Daily observations were recorded on the condition of the plants. Physico-chemical analyses of water of all five cisterns were also done at regular intervals. The results are summarized in Table I.

From Table I it is seen that even after lowering the pH to 6.0 a dose of copper sulphate as high as 10 p.p.m. is required for complete destruction of plants. Plants first lost their natural colour, became soft in texture and in about 15 days they sank to the bottom partially decomposed. Complete destruction was obtained after 28 days. The maximum decomposition period was associated with very low dissolved oxygen, comparatively lower pH and the colour of the water turned brownish.* Twenty-eight days after the beginning of the experiment, the water started clearing but some decaying odour persisted even up to the 39th day and the water assumed its normal clear, odourless condition in 47 days. From the 39th day zooplankton, such as rotifers and cladocera and phytoplankton such as species of *Closterium*, and *Oscillatoria* made their appearance; slight increase in essential nutrients like nitrate and

* Unpublished chemical data supplied by Mr. S. M. Banerjee, Research Officer (Chemistry), Central Inland Fisheries Research Sub-Station, Cuttack.

TABLE I
Showing condition of plants *Hydrilla verticillata* after treatment with acid and copper sulphate

	Cistern 1 Control	Cistern 2 Acid + 2 p.p.m. of CuSO_4	Cistern 3 Acid + 6 p.p.m. of CuSO_4	Cistern 4 Acid + 10 p.p.m. of CuSO_4	Cistern 5 Acid only (pH 5.0-6.0)
After 2 days ..	Plants healthy	Plants soft in texture with loss of colour	Same as in cistern 2	Same as in cistern 2	Plants lose brightness of colour
After 6 days ..	do.	Same as before with root tips affected	do.	do.	Leaves turned reddish
After 15 days ..	do.	Plants regaining healthy condition	Some surface layer plants completely decayed	All the plants sunk and partially decayed	More leaves turned reddish
After 24 days ..	do.	Plants healthy	Plants regaining healthy condition	Plants sunk at the bottom almost completely decomposed	Leaves regaining original healthy green colour
After 28 days ..	do.	do.	Plants healthy	All plants completely decomposed, water turned brownish	Plants healthy and green
After 34 days ..	do.	do.	do.	Brownish colour became lighter but water developed bad odour	do.
After 39 days ..	do.	do.	do.	Bad odour less, colour turned reddish brown, zooplankton and phytoplankton appeared	do.
After 47 days ..	do.	do.	do.	No odour, water slightly greenish, more phytoplankton present	do.
After 54 days ..	do.	do.	do.	do.	do.

phosphate was also observed. Thus, while the fish food showed no adverse effects and thrived normally, weed was totally eliminated when the highest dose of copper sulphate (10 p.p.m.) under slightly acidic condition was applied. Plants of cistern (5) in which the pH of the water was maintained between 5.0 and 6.0 by the daily application of commercial sulphuric acid showed no detrimental effects.

In the second series of experiments, comparative study was made on the effect of adding this optimal dose of 10 p.p.m. of copper sulphate in different ways.

A dense and healthy growth of *Hydrilla verticillata* was obtained in five cement cisterns and the chemical was applied in the following manner:

Cistern 1—Control.

Cistern 2—10 p.p.m. of copper sulphate all at once without lowering the pH.

Cistern 3—10 p.p.m. of copper sulphate all at once after lowering the pH of the water.

Cistern 4—10 p.p.m. of copper sulphate added serially at 2 p.p.m. for 5 alternate days, the pH being adjusted to 6.0 for each application.

Cistern 5—10 p.p.m. of copper sulphate added serially at 1 p.p.m. for 10 consecutive days, pH being adjusted to 6.0 for each application.

To study the effect of different doses on fish, three specimens of *Labeo rohita* 70 to 90 mm. long were introduced into each cistern. They were kept in cages, about one cubic foot each, made of nets in order that their condition could be observed easily. Periodical observations were carried out on the nature of plants, condition of fish and composition of the plankton population in water. Physico-chemical composition and the Cu^{++} ion concentration of water were also estimated at regular intervals.*

Observations on plants

It is observed that on application of 10 p.p.m. of copper sulphate without any prior acid treatment 50% of the plants die in 28 days. But the surviving plants revive and regain their healthy growth. In treatment 2 (10 p.p.m. of copper sulphate after lowering the pH to 6.0), the plants were found to be completely destroyed and decomposed within about 28 days, no sign of survival being observed in next three weeks. Among the serial treatments, a dose of 2 p.p.m. of copper sulphate for five alternate days seems to be more effective than 1 p.p.m. of copper sulphate for 10 consecutive days. In the former, 95% of plants were completely killed and decomposed in 28 days and the surviving plants later regained healthy condition.

Observations on plankton

Ten litres of water from each cistern were strained through a bolting silk net and plankton was examined qualitatively. Before treatment with chemicals, very little plankton was noticed in each cistern. From two to three days after treatment, the plankton population in all the treated cisterns was completely eliminated. The effect, however, was not permanent. After about two weeks few phytoplankton, such as *Navicula* sp., *Euglena* sp., made

* Unpublished chemical data supplied by Mr. S. M. Banerjee, Research Officer (Chemistry), Central Inland Fisheries Research Sub-Station, Cuttack.

	CISTERN 5					
	Acid and 1 p.p.m. copper sulphate for 10 consecutive days					
	Temp. °C.	Turb.	Col.	Odour	pH	D.O., p.p.m.
Before treatment	31.3	cl.	cl.	n.	9.6	6.6
After treatment	32.3	cl.	cl.	n.	6.8	7.0
After 1 day	31.8	cl.	cl.	n.	8.1	6.0
After 2 days	31.9	cl.	cl.	n.	7.2	5.8
After 3 days	32.6	cl.	cl.	n.	6.9	2.9
After 4 days	33.0	cl.	cl.	n.	6.7	1.0
After 5 days	32.8	cl.	cl.	n.	6.7	0.8
After 6 days	30.6	cl.	cl.	n.	6.7	1.4
After 7 days	31.7	cl.	cl.	n.	6.7	2.8
After 8 days	32.3	cl.	cl.	n.	6.7	0.75
After 9 days	32.6	20	Brownish	Organic	6.6	1.5
After 16 days	31.3	20	do.	do.	6.9	2.4
After 21 days	31.5	20	do.	do.	7.6	2.6
After 28 days	32.6	cl.	cl.	n.	8.6	5.1
After 35 days	30.0	cl.	cl.	n.	8.5	7.0

their appearance. After about 7 weeks phytoplankton was found in sufficient quantity in all the cisterns.

Observations on the quality of water

Results of physico-chemical examination are summarized in Table II. As the experiment was conducted in the summer months of May-June, water temperature was high and ranged from 30°–33°C. Turbidity was below 10 p.p.m. in all the cisterns and has been noted as clear. Lowering of pH by acid treatment was only temporary and it was generally observed that there was a rise of about 1 unit in pH in the first 24 hours after acid treatment; subsequent rate of rise was, however, slower. The lowest dissolved oxygen content recorded was 0.75 p.p.m. in cistern (5) and in all the treated cisterns there was a period of low dissolved oxygen (1.2 p.p.m.) for about two weeks. At the period of maximum decomposition, the water turned slightly brownish with a faint smell of decomposed organic matter which lasted for about a week.

Observations on Cu^{++} ion concentration in water

Systematic examination of the Cu^{++} ion concentration was made to study the removal of the Cu^{++} ions from the aquatic phase. It will be seen from Table III that the rate of removal of Cu^{++} ion from water, either in the alkaline or in the acidic condition, is directly proportional to the Cu^{++} ion concentration of the medium. Both the cisterns (2) and (3), treated with 10 p.p.m. of copper sulphate, nearly 70% of the Cu^{++} is removed in 24 hours either by precipitation or by adsorption while in cisterns (4) and (5) treated with 2 p.p.m. and 1 p.p.m. the removal after 24 hours is 60% and 36% respectively. It may be noted, however, that whether added all at once or in serial doses, the copper ion concentration in all the treated waters after 10 days is practically similar and ranges between 0.78 and 0.98 p.p.m. After this Cu^{++} ion is removed very slowly and the water is practically free from soluble copper only after about two weeks.

Observations on fish

The fish *Labeo rohita* were obtained from Kila fish farm, Cuttack, and kept in aquaria for 48 hours before they were introduced in the cages placed in the cisterns. Lowering of pH by acid did not appear to have any detrimental effect on fish since no sign of distress or restlessness was noticed. But immediately after the addition of copper sulphate, fish in all the treated cisterns became very restless and tried to jump out of the cages. In cistern (3) treated with acid and 10 p.p.m. of copper sulphate, their restlessness increased very much and after some time their movements became erratic and all the fish died in 4 hours' time. The dead fish were replaced by a fresh set of three but these also died after 8 hours. The copper ion concentration fell below the lethal limit after 12 hours and the third set of fish survived up to the end of the experiment. In cistern (2) where 10 p.p.m. of copper sulphate was added all at once without acid treatment and in cisterns (4) and (5) where 10 p.p.m. of copper sulphate was added serially after treatment with acid, fish slowly recovered from their state of disequilibrium and continued to remain alive. One fish each in cisterns (4) and (5), however, died and was replaced during the course of the experiment (Table IV).

Discussion

Copper sulphate is known for its efficacy as algacide for a long time. Varied results obtained with the same chemical by different workers

TABLE III

Showing Cu^{++} ion concentrations in differently-treated cisterns (Experiment No. 2)

	CISTERN 1	CISTERN 2	CISTERN 3	CISTERN 4	CISTERN 5
	Control	10 p.p.m. of copper sulphate	Acid and 10 p.p.m. of copper sulphate	Acid and 2 p.p.m. of copper sulphate for 5 alternate days	Acid and 1 p.p.m. of copper sulphate for 10 consecutive days
Before treatment	nil	nil	nil	nil	nil
After treatment	nil	8.20	8.80	1.60	0.88
After 4 hours	nil	—	7.20	—	—
After 12 hours	nil	3.30	3.60	1.00	0.80
After 24 hours	nil	2.40	3.20	0.80	0.64
After 36 hours	nil	2.20	3.08	0.68	1.40
After 2 days	nil	2.00	2.68	0.56	0.84
After 3 days	nil	1.50	1.66	1.30	1.08
After 4 days	nil	1.48	1.60	0.69	1.20
After 5 days	nil	1.46	1.50	1.20	1.40
After 6 days	nil	1.30	1.10	0.67	1.00
After 7 days	nil	1.20	0.90	0.89	1.00
After 8 days	nil	1.00	0.80	0.57	0.80
After 9 days	nil	0.98	0.78	0.82	0.98
After 16 days	nil	0.28	0.28	0.26	0.28
After 21 days	nil	0.14	0.14	0.12	0.12
After 28 days	nil	trace	trace	trace	trace

TABLE IV

Showing conditions of fish in differently-treated cisterns (Experiment No. 2)

	CISTERN 1	CISTERN 2	CISTERN 3	CISTERN 4	CISTERN 5
	Control	10 p.p.m. of copper sulphate	Acid and 10 p.p.m. of copper sulphate	Acid and 2 p.p.m. of copper sulphate for 5 alternate days	Acid and 1 p.p.m. of copper sulphate for 10 consecutive days
Before treatment	All living	All living	All living	All living	All living
After treatment	do.	do.	do.	do.	do.
After 4 hours	do.	do.	All dead and replaced	do.	do.
After 12 hours	do.	do.	do.	do.	do.
After 24 hours	do.	do.	All living	do.	do.
After 36 hours	do.	do.	do.	do.	do.
After 2 days	do.	do.	do.	do.	do.
After 3 days	do.	do.	do.	do.	do.
After 4 days	do.	do.	do.	One dead and replaced	do.
After 5 days	do.	do.	do.	All living	One dead & replaced
After 6 days	do.	do.	do.	do.	All living
After 7 days	do.	do.	do.	do.	do.
After 8 days	do.	do.	do.	do.	do.
After 9 days	do.	do.	do.	do.	do.
After 16 days	do.	do.	do.	do.	do.
After 21 days	do.	do.	do.	do.	do.
After 28 days	do.	do.	do.	do.	do.

suggest that the efficacy of a chemical weed killer depends to great extent on the chemistry and physics of the medium and the nature and type of the weed and the purpose for which it is used. If these factors are taken into consideration, each chemical weed killer, whether simple or complex in structure, will find its use in the field as a weedicide. For killing terrestrial and amphibious aquatic weeds the chemical is brought directly in contact with the plant body by spraying it on the exposed parts; for submerged weeds, however, water is the first recipient of the chemical and it is transmitted later to the plant body. Hence, for the treatment of submerged weeds, the chemistry and physics of water to be treated need special examination and consideration. O'Donell (1945) and Surber (1943) have used copper sulphate for controlling submerged algal weeds and have pointed out that the drawback of the chemical lies in being removed as copper hydroxide by alkaline waters. Preliminary observations by Banerjea and Mitra (1954) suggest that this difficulty may be overcome by reducing the pH of the water by acid treatment and the weed *Ottelia alismoides* can economically be controlled with copper sulphate and commercial sulphuric acid. This method is useful only in cases like the preparation of nursery ponds or reclamation of weed-infested abandoned water areas where death of fish is no consideration. While the present experiments on *Hydrilla verticillata* confirm the previous observations, they are significant in pointing to the fact that the death of fish can be prevented by adding the dose of copper sulphate (10 p.p.m.), not all at once, but serially, so that the copper ion concentration in the aquatic phase is kept below the lethal limit. Of the two serial doses one at 2 p.p.m. for five alternate days and the other at 1 p.p.m. for ten consecutive days, the former is comparatively better as it kills about 95% of the weeds in 28 days. Its efficacy, however, is slightly less when compared with the all at once doses since the surviving weeds (5%) regain normality later and have to be removed manually. Further, the success of a chemical weed killer depends to a great extent on the thorough and uniform distribution of the chemical on the watery medium in which fish life thrives.

Even after a fairly successful chemical treatment of aquatic weeds, a very minor fraction of the plants with vegetative reproductive organs or stages are left over the muddy bottom and these are difficult to eradicate. If these are not removed in time, the propagative bodies may slowly regain their original healthy condition and establish themselves in the water mass in a short time. It is, therefore, always expedient that mechanical means may be adopted for the removal of the remaining dead plants. With serial doses, the Cu^{++} ion concentration of water was maintained below 2 p.p.m. and though the medium was kept slightly acidic (pH 6.0–7.0) for a number of days by acid treatments this dose was never lethal to fish. The low dissolved oxygen content maintained for a number of days during the decomposition of the organic matter of the plant bodies may be regarded as adverse to the health of fish but is not lethal; even the synergetic action of this low dissolved oxygen and the toxicity of 2 p.p.m. of copper sulphate did not prove lethal to fish life. One fish, however, died in each of cisterns (4) and (5). This was probably due to its inherent low power of resistance. That copper sulphate of the proper dosage had no cumulative effect in killing fishes was shown by the fact that the fish, kept under observation in earthenware tubs for about five weeks after the experiment, lived quite normally though they looked unhealthy as a result of being confined to a limited space probably with inadequate supply of food.

It is thus observed that application of copper sulphate after lowering the pH kills both *Ottelia alismoides* and *Hydrilla verticillata* when they are growing as annual vegetation.

2. Ponds in Bengal have submerged, perennial, rooted vegetation growing for years. Such ponds have fish in them but it is very difficult for the fish farmer to catch and market these fish as the heavy growth of vegetation obstructs the fishing net and also frequently allows the fish to hide themselves in the deeper parts of the ponds. It is essential to clear such ponds of the vegetation without regard to the life of the fish source as fish can be replanted later. Surber (1949) is of opinion that copper sulphate is cheap and can be used extensively where the water is hard. He has shown that 1 p.p.m. of copper sulphate controls *Chara* and floating algae which sometimes cover the surface of hatchery ponds. So copper sulphate, the easily available and inexpensive chemical, was employed in an effort to clear a tank infested with submerged, rooted, perennial vegetation. The duration of growth of plants, which is a very important factor in weed control, was taken carefully into consideration.

Presence of vegetation in the pond

Two ponds inside the compound of the National Library (formerly, Viceregal Palace), Calcutta, situated side by side were used for investigation. In both tanks *Hydrilla verticillata* and *Chara zeylanica* were found to grow in abundance and in close association for many years. It was also gathered that the tanks are cleaned by manual labour once every year. Occasionally 1 ft. depth of the bottom soil was desilted; in spite of this the growth of the aquatic vegetation was not checked. This expensive mechanical cleaning was carried on for many years in vain and was discontinued about the year 1942. In 1954 when the Central Inland Fisheries Research Station took over the tanks for fish culture, it was immediately realized that the problem of congestion of tanks should be tackled before any experiments on fish culture could be undertaken.

The water expanse at that time measured was 320' × 65' × 5' (length × breadth × depth) and the water level of the tank was maintained through a feeding inlet pipe bringing in the Ganges water. From the middle of January, the inlet pipe and the connection with the adjoining tank were closed. The volume of water was reduced in order to use the chemicals economically in course of experiments on the chemical control of submerged perennial aquatic vegetation.

Experiments and results

In March, 1955, the depth of water was reduced to about 3½ ft. and the surface area to approximately 90 sq. ft. The vegetation in the water was so thick and crowded that it was difficult even to see the water. The tank was treated with copper sulphate after lowering the pH.

The first treatment was on 18-3-55. The abundant vegetation renders it very difficult to lower the pH particularly on hot days when the pH of water rises rapidly in the early morning hours. So, in the evening between 4-0 and 5-30 p.m. 4 lb. of commercial sulphuric acid was added to the tank and the pH of the water was lowered from 9.6 to 7.4. Copper sulphate was now added at 10 p.p.m. The pH of the water remained low only for a few hours, as, after about 10 hours, it rose to 9.5. The second treatment was on the 12th day (30-3-55) after the first treatment. After the application of 5 lb. of commercial sulphuric acid, the pH was lowered from 9.6 to 6.8 when 10 p.p.m. of copper sulphate was added. After about 3 hours the pH rose to 9.8. The third treatment was done on 13-7-55, 105 days after the second treatment. After the application of 4 lb. of commercial sulphuric

acid the pH was lowered from 8.8 to 6.2; 10 p.p.m. of copper sulphate was then added.

Observation on plants

From the fourth day after the first treatment, roots of both species showed signs of decay. On the 11th day some of the *Chara* plants showed complete decomposition of some parts but plants composing the larger bulk of the vegetation showed only faded leaves. Among *Hydrilla* plants, those reaching the surface layer of water showed signs of decay while others with strong roots showed only faded leaves.

Two days after the second treatment (15th day from the first treatment) roots of all the *Chara* and *Hydrilla* plants showed signs of decay. On the 30th day, 95% of the total vegetation decayed giving blackish colour and decaying smell to the water. The non-decayed but decomposed vegetation (5%) which was still floating was removed manually. When the vegetation was taken out, the whole of the bottom mud was searched for rooted stumps of the vegetation and none was found. After 24 days from the second treatment, small healthy green twigs of *Chara zeylanica* appeared at the bottom of the tank. These were allowed to grow. Water was treated for the third time on the 106th day from the second treatment. Ten days after the third treatment, hand rakes were drawn at the bottom and it was observed that the scattered vegetative parts of *Chara* were black in colour and decomposing. *Hydrilla* plants were nowhere to be found.

For almost five months the depth of water was kept low and the vegetation on the previously submerged areas of the sloping sides was exposed to strong sun. The plants completely dried up after about three months. The sides were now raked so that the underground parts of this dried vegetation, if alive and left over, would be exposed to the sun. The low volume of water helped the penetration of sunlight up to the bottom soil and thereby allowed the water to lose the unwanted gases and other chemical elements caused by the decaying plants. When the inlet pipe was opened on 29-7-55, the vegetation present within the tank had been killed and decomposed by treatment with copper sulphate and plants on the marginal area were completely dried and mixed with the dry soil.

Observation on fish

The tank was full of *Barbus* sp. Twenty per cent of the fish died within 5 to 6 hours of the first application of copper sulphate and the rest showed some restlessness for a few hours though they became quite normal later. From 5-4-55, when the water began emitting bad odour from the decayed plants, the fish again showed restless behaviour and started dying. Only 10% of the fish survived by the 30th day, when the half-decomposed vegetation was manually removed from the pond. Thus 90% of the *Barbus* sp. were destroyed by the action of copper sulphate as well as by the depletion of oxygen caused by the decomposed vegetation. The inlet pipe of the pond was opened on 29-7-55, 17 days after the third treatment. On 27-8-55, a stock of major carp fingerlings, rohu, catla and mrigal approximately 2,500 in number, was liberated. Catla is known to be the fastest-growing fish among the major carps. From the growth of fish it can be stated that the application of copper sulphate did not affect the culture and growth of these major carps adversely. The growth of fish is tabulated in Table V.

Here also catla has shown the maximum growth. Average length 305.14 mm., average weight 516.64 gm. in a period of 8½ months. Rohu has shown good growth, that is, average length 188.83 mm. and average weight 115.33 gm. Mrigal also showed good growth, that is, average length 231.2 mm. and average weight 169.06 gm.

TABLE V

Growth of fish in a tank after treatment with copper sulphate

Types of fish	When liberated		After 8½ months		Growth in 8½ months	
	Average length	Average weight	Average length	Average weight	Average length	Average weight
1	2	3	4	5	6	7
	mm.	gm.	mm.	gm.	mm.	gm.
<i>Catla catla</i>	30.9	0.31	336.04	516.95	305.14	516.64
<i>Labeo rohita</i>	30.02	0.29	218.85	115.62	188.83	115.33
<i>Cirrhina mrigala</i>	29.8	0.24	261.0	169.3	231.2	169.06

Observation on water quality

The pH of water was lowered from 9.8 to 7.6 on 18.3.55 and 10 p.p.m. of copper sulphate was added. After about 10 hours, the pH was again 9.2. On the 8th day after treatment, the dissolved oxygen was lowest, that is, only 6.0 p.p.m. When the plants were decomposing the water had a blackish colour with a decaying odour.

For the first two treatments, the pH was lowered before the application of copper sulphate but the water could not be kept acidic for long; hence the copper precipitated as the water became alkaline and hence the plants could not absorb the copper as long as it was present in solution in the water. Only a small portion of the copper sulphate added to the water was absorbed by the vegetation. It has already been shown (Table II) that after lowering the pH and adding 10 p.p.m. of copper sulphate the pH of the water continued to be low for about two weeks and some of the Cu^{++} ions remained in solution during the period. The Cu^{++} ion content during this period changed from 8.8 to 0.78 p.p.m.

Discussion

The results of experiments described indicate that aquatic plants are affected by copper sulphate in two ways. First, the Cu^{++} ion absorbed by the floating vegetative parts travel down to roots and the decay starts from the roots and thus the absorption of nutrient elements by the roots is checked to some extent.

When copper sulphate was added to water after lowering the pH it remains in solution as long as the pH of the water is low. In this state, the leaves and other vegetative parts of the plants can absorb the Cu^{++} ion present in solution in water. After some days the leaves lose their natural green colour and turn yellow. By the absorption of copper sulphate, chlorophyll *a* and chlorophyll *b* are destroyed and photosynthesis of the plants is completely stopped. Later the decay of the roots checks the absorption of nutrient elements and together with the destruction of chlorophyll *a* and chlorophyll *b* present in the foliage cells, decomposition of the plants results.

Chemicals should not be applied during rains as the concentration of the acid as well as of the copper sulphate added to the tank water will then be reduced.

TABLE VI
Laboratory experiments : observations on plants treated with superphosphate

Date	Treatment made	Number of days	RESULTS		
			On plants	On fish	Control
<i>Experiment No. 1</i> 28-5-55	500 p.p.m. of super-phosphate		Very healthy <i>Hydrilla</i> plants.	nil	Very healthy <i>Hydrilla</i> plants.
11-6-55		15	85% of the plants dead and decayed, the rest 15% floating in an unhealthy state.		
16-6-55			25 germinated turions present.		
20-6-55		24	All the plants dead and decayed. The water is very dark in colour and turbid, giving a bad smell. The plants germinated from the turions are healthy.		All plants growing healthily. No germinated turions found.
<i>Experiment No. 2</i> 7-7-55	500 p.p.m. of super-phosphate		Very healthy <i>Hydrilla</i> and <i>Vallisneria</i> plants present.	nil	Very healthy <i>Hydrilla</i> and <i>Vallisneria</i> plants present.
16-7-55			The plants half-decayed and the water has a bad odour.		
21-7-55		15	85% of <i>Hydrilla</i> dead and completely decayed. 15% floating in a very unhealthy and in a half-decayed condition. All <i>Vallisneria</i> plants uprooted. The roots are all black and decaying, most of the leaves in a decaying condition.		•••
1-8-55		24	All <i>Hydrilla</i> dead and decayed. All the <i>Vallisneria</i> plants floating with half-decayed leaves. The water dark in colour and with a bad odour.		All plants growing healthily.

Experiment No. 3 29-8-55 500 p.p.m. of super-phosphate		Very healthy <i>Hydrilla</i> and <i>Limnanthemum cristatum</i> present.	25 major carp fry present.	Very healthy <i>Hydrilla</i> and <i>Limnanthemum cristatum</i> plants present.
1-9-55		Plants healthy.	Fish healthy.	
3-9-55		Leaves lost the green colour.	Fish healthy.	
5-9-55		Parts of plants decaying, 80% phytoplankton dead, zooplankton living healthily. Water with a bad smell.	5 fish dead.	
12-9-55	15	50% of the floating <i>Hydrilla</i> decayed and the other 50% in a half-decayed condition. The leaves of <i>Limnanthemum</i> decayed but the roots are strongly embedded in soil.	All the fish dead.	
21-9-55	24	All <i>Hydrilla</i> plants dead and decayed <i>Limnanthemum</i> still with strong roots but decayed leaves.		All plants healthy.

II. BY MEANS OF FERTILIZER

3. It is often observed that fish nursery tanks have an abundance of rooted, submerged vegetation in them. Before the spawning season, fish farmers have to clean these tanks by manual labour, which is often expensive. So laboratory and field experiments were carried out with some chemical, such as superphosphate (double and commercial) which is usually used as fertilizer for fish ponds, to find out if the vegetation in these tanks could be destroyed without killing the fish population present in the tank, and whether by this method the recurring expenditure of the fish farmers could be avoided.

Rooted aquatic plants often benefit from fertilization with phosphorus. Breest (1921, 1925), Walter (1924, 1925, 1926, 1934) and Nees (1946) worked with superphosphate as fertilizer but none used the chemical for controlling vegetation. After many years of experimentation, Walter (1926) decided that about 17 kilograms per hectare of phosphorus (applied as superphosphate) was an optimum dose. In a variety of ponds he was unable to increase his yields further by application of higher doses.

Laboratory experiments on the use of commercial superphosphate were carried out on plants growing for three or four months in earthenware tubs. When used alone, it acts as a fertilizer for *Hydrilla verticillata* up to 150 p.p.m. Plants treated with 150 p.p.m. of superphosphate are found to have healthier vegetative parts, bigger leaves and are more vigorous. But when the water in which *Hydrilla* plants are thriving is treated with 500 p.p.m. of superphosphate, instead of acting as a fertilizer it acts as a weed killer. The dosages between 150 and 500 p.p.m. do not kill *Hydrilla* completely but some damage is caused to the plants. Treatment with 500 p.p.m. of superphosphate was repeated thrice each with similar results (Table VI). Later the experiment was carried out under natural conditions in a pond with success.

From the experiments it is observed that from the 5th and 6th days after treatment, the foliage leaves lose their green colour and become reddish yellow. From the 8th to 9th day the roots of *Hydrilla verticillata* and *Vallisneria spiralis* become loose. After 15th day all the plants are uprooted. In 24 days all the *Hydrilla verticillata* plants are completely dissolved in water and *Vallisneria spiralis* float in a half-decayed condition.

As stated by Breest (1921), phosphate is absorbed by the soil and from this soil by the plants. Plant physiologists have already stated that excess of phosphate affects the nitrogen cycle of the plant metabolism. Hence excess of phosphate resulted first in the decay of the roots and later of other vegetative parts. When plants decay completely, the oxygen content of the water also becomes very low; in such an environment fish cannot exist. When the chemical is applied, the fish do not seem to be affected adversely. They are affected only when there is depletion of oxygen. The death of fish is thus not due to the direct effect of the chemical on them, but is rather the indirect result of decaying and decomposed plants which reduce the oxygen content of the water below the optimum needs of fish.

Condition of the water before and few days after treatment :

	Before treatment	12th day after treatment
pH	7.8	6.6
Dissolved oxygen	2.6 p.p.m.	nil
Alkalinity	250 p.p.m.	150 p.p.m.

4. *Field experiment*.—A pond measuring 96 ft. x 72 ft. with an average depth of about 5 ft. 5 inches at Kadamtalla, about six miles away from Howrah Station, was chosen for experiments. The pond belonged to a member of the fish seed syndicate and was used for the liberation of the fish spawn during the spawning season. As rooted, submerged vegetation (*Hydrilla verticillata*) grows very vigorously in this tank and chokes it up very quickly, the fish farmer has to clean the tank and get it ready for the liberation of spawn each season.

When the tank was taken over by our Department, it was found choked up with *Hydrilla verticillata*. The following species of fish were also present in sufficient quantity :

<i>Labeo rohita</i>	152–332 mm.
<i>Catla catla</i>	200–350 mm.
<i>Cirrhina mrigala</i>	150–230 mm.
<i>Labeo calbasu</i>	150–223 mm.
<i>Cirrhina reba</i>	100–172 mm.
<i>Barbus</i> sp.	75–103 mm.

Among the whole stock 50% were *Labeo rohita*, *C. catla*, *C. mrigala* and *L. calbasu* and the other 50% were *C. reba* and *Barbus* sp. Due, obviously, to the excess of vegetation the major carps were poor in health and quality.

The tank was treated with 500 p.p.m. of double, commercial superphosphate between 11-0 a.m. and 2-30 p.m. On the 6th day the plants emitted decaying odour at the underground roots only, some of which had a black coloration also. By the 10th day 60% of the underground roots decayed and the rest were in a decaying state. The bottom soil also had a decaying odour. On the 18th day 99% of the rooted vegetation were uprooted though the remaining plants were still very loosely rooted in the soil.

After treatment none of the fish showed any sign of abnormality and all of them survived. During the period of the experiment the chemical condition of the tank water was as the following :

Date	pH	D.O., p.p.m.	Alkalinity, p.p.m.	Phosphate, p.p.m.	Oxygen con- sumed, p.p.m.
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Before treatment

3-3-56	8.1	4.4	140	0.1	20
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After treatment

5-3-56	8.1	4.3	150	95	21
12-3-56	8.0	1.4		97	
15-3-56	8.0	1.9		170	
19-3-56	7.8	3.0			
21-3-56	8.0	3.4		150	
28-3-56	8.0	5.2		100	
12-4-56	8.2	4.8		120	
25-4-56					
Surface	8.3	3.6		120	
Bottom	8.1				

If the uprooted plants had been allowed to decay within the water, oxygen would have been depleted and led to the death of the fish population. To avoid fish mortality, on the 18th day when the plants were all uprooted, the vegetation was taken out of the pond by dragging a thick rope through the surface layer of the water. The 1% vegetation that was still loosely rooted in the soil was pulled out and thrown away. Thus the water was almost completely cleared of all the vegetation. The bottom soil had a decaying odour and the water had a slight decaying smell too, but the fish were still present in a healthy state. After a week, the tank was replete with zooplankton and a little phytoplankton.

The growth of vegetation can be checked by other methods, namely, use of manual labour, mechanical means such as using common implements as rakes, drying the tanks and biological means. The results of different methods of experiments are as follows.

III. OTHER METHODS

5. *By means of manual labour.*—A tank measuring 362' × 110' with an average depth of 5 ft. was used for this experiment. It contained *Hydrilla verticillata* in abundance near the marginal area up to about 3 to 4 ft. depth of water. The growth of the vegetation was so thick that netting of the tank was almost impossible. Four labourers were employed for three consecutive days, that is about 6 to 7 hours per day, and the marginal area up to about 3 ft. depth of water was cleared of the vegetation. Hydrobiological observations were taken each week and a watch was kept on the marginal area and plants noticed near the sides were picked up and thrown away. For three to four months after cleaning, the growth of new plants were very vigorous and they had to be constantly taken out and removed. Thus, by repeated cleaning, growth of new plants was reduced. Once a month, the sides of the pond were cleaned and thereby the growth of *Hydrilla verticillata* was controlled. Such constant watch for about six months gradually suppressed the growth of the underground vegetative parts and further development of plants was reduced to the minimum. Cleaning up of ponds by manual labour is successful only where labour is cheap and easily available on the spot. The operation will have to be repeated for a very long period, too. Lack of attention and delay in timely action prolong the operation and the cleaning work becomes more difficult.

6. *By mechanical means.*—In India hand rakes are very commonly used, but they are not found to be very helpful in controlling the weeds. As the rakes are drawn, portions of the rooted vegetation get torn. Thus none of the underground vegetative parts can be eradicated. If they are not disturbed for about a month, the tank is covered with dense vegetation as before. From actual field experiments it has been found that uprooting, and picking the plants by manual labour, is much better and quicker than the use of the rakes or other implements. In India this operation, known as 'Pankoddhar' consisting of lifting of mud and netting and other manual operations in proper season, is practised in villages from time immemorial with desirable results.

7. *By means of drying the tanks entirely or in parts or desilting.*—Drying is possible only with small ponds or where the volume of the water can be controlled very easily. Experiment was done in a pond containing water in an area of length 320 ft., average width 65 ft., average depth 6 ft., and it was maintained by inlet pipes. These pipes were kept closed and the volume of the water gradually got reduced due to evaporation. The pond was full of *Hydrilla verticillata* and *Chara zeylanica*. After keeping the inlet

pipes closed for about two months the volume of the water was of length 20 ft., average width $4\frac{1}{2}$ ft. and average depth $3\frac{1}{2}$ ft. When the volume of the water was reduced, the marginal area previously under water was exposed to the sun along with all the vegetation on it. The area was exposed to the bright sun for about four to five months and as a result all the *Hydrilla* and *Chara* plants were completely dried. The rakes were then used on the dry soil but no living underground parts were present. At the end of the period the inlet pipe was opened and the water volume was raised to its former level. None of the aquatic plants that were present previously appeared on portions of the water space which was kept exposed to the sun for about four to five months, and also later.

8. *By biological means.*—Experiments were carried out in the earthenware tubs. In three tubs (each of diameter 21", depth 11") *Hydrilla verticillata* were grown for four months. The growth of the vegetation was very healthy and the tubs were completely overgrown with the plants. One tub was kept as control and *Lemna trisulca* and *Azolla pinnata* were introduced in the others, completely covering the surface layer of the water in both. *Azolla pinnata* grew more vigorously and the surface cover became thicker later. Some fingerlings of major carps were liberated in all the three tubs. The *Hydrilla* plants were covered by the floating *Azolla* plants, and in nine to ten days the root tips of about 50% plants showed black coloration and 1% of the foliage leaves were dead and decayed. Fish continued to be healthy. From the 13th to 15th day the root tips of all the roots were dead and 75% of the roots were half-decayed and the rest of the roots were very unhealthy. The plants were also getting detached from the soil and the leaves lost the healthy green colour. Water developed bad odour and the fish were dying. From the 16th to the 18th day, 75% of the plants were in a decomposed state and all the plants were floating. Between 22nd and 25th day, 99% of the vegetation was decayed and the water had red colour and bad odour. After about 78 days one or two small, delicate plants with unhealthy colourless leaves were present. After 90 days the *Azolla* and *Lemna* plants were removed and the water was exposed to sunlight completely. A small number of unhealthy plants present were also picked up and thrown away. After about four to five days' exposure to sunlight, the water was transparent and odourless and carp fingerlings were liberated. These were found to survive and grow normally.

It has been found experimentally that treatment of the medium with 150 p.p.m. of superphosphate induces quick multiplication of both *Azolla pinnata* and *Lemna trisulca*. When *Azolla pinnata* or any species of *Lemna* are liberated in such treated water, these floating plants multiply vigorously and within a few days cover the surface. Water should be undisturbed for 18 to 20 days and then a drag net should be drawn through the water. At this time the roots of all the rooted vegetation are very delicate and the drag net will help them to get detached from the soil and float. These plants can be collected by the drag net instead of allowing them to decompose in the water and thrown away from the tank. The surface can be kept covered up again with the floating vegetation, thus cutting the penetration of light through the water and helping to check the growth of the underground vegetative parts of the plants. The fish population present in the tank will not be affected by this method. The tank might not be completely free from vegetation but the growth of at least the main bulk of the rooted, submerged vegetation is suppressed; the rest can be removed mechanically by rakes. This method is not expensive.

From these results of the weed control experiments carried out in the laboratory and in the field, it can be stated that chemical control is successful

in combination with manual labour. The chokage in the tank is so heavy that simple chemical treatment is not often sufficient to clean the tank completely. If, however, only one tank in an area is treated and the rest of the tanks in the same area are left over, then the treated tank will again be infected with parts of aquatic vegetation from the neighbouring tanks. Therefore, tanks in each area should be taken up in a planned and systematic manner. Only then can the weed control problem be tackled in a more efficient manner.

SUMMARY

Chemical, fertilizer and other methods of weed control, practicable in fresh waters used for fish culture, are outlined.

Addition of copper sulphate at 2 p.p.m. on 5 alternate days, after reducing the pH of water slightly by use of sulphuric acid, destroys 95% of the population of *Hydrilla verticillata* without affecting fish. Application of 10 p.p.m. of CuSO_4 after lowering the pH acts as a weedicide for *Hydrilla* and *Chara zeylanica*. This dosage killed the *Barbus* sp. present in the tank.

Whereas commercial superphosphate, up to 150 p.p.m., acts as a fertilizer, at 500 p.p.m. it is a weedicide for *Hydrilla* and *Vallisneria*.

Removal of weeds by mechanical means (hand rakes, etc.) is less efficient than the use of manual labour; the latter is economical only when labour is inexpensive. Entire or partial drying of tanks or desilting them destroys vegetation only in the areas concerned.

As a method of biological control, seeding the tank with *Lemna trisulca* and *Azolla pinnata* was tried. These fast-multiplying plants cover the water surface soon and the submerged *Hydrilla* vegetation is destroyed. However, *Lemna* and *Azolla* have to be removed later by a drag net.

On the basis of these experiments, it is considered that chemical control in combination with some manual operation is the most efficient and economical method.

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COLONEL POLIER'S ACCOUNT OF THE SIKHS

Edited by

GANDA SINGH

INTRODUCTORY

Colonel Polier's *The Siques* is the first known connected account of the Sikh people written by a European. According to internal evidence provided by references to Mirza Najjaf Khan's hostilities against the Macheri chief (Rao Raja Partap Singh) in 1779-80, the death of Ahmad Shah Durrani (on the night of October 16-17, 1772) 'which had happened about eight or nine years ago', and the conquest of Multan from the Sikhs by Taimur Shah Durrani in February 1780,¹ this paper was written in 1780 (see footnotes 24 and 35). Some eight years later, it was read at a meeting of the Asiatic Society of Bengal (now the Asiatic Society) at Calcutta on December 20, 1787. No copy of it seems to have been left with the office of the Society, nor was it published in the Society's *Journal*. The present copy has been obtained from the India Office Library, London (Orme MS., XIX, pp. 73-83), and I am thankful to its Librarian for his courtesy in arranging to let me have a photostat copy.

Antoine Louis Henri Polier, as that was the full name of Colonel Polier, was a Swiss engineer, nephew of Paul Phillip Polier, the Commandant of Fort St. George (Madras). He entered the service of the East India Company in 1757 and arrived in India in 1758. Having for some time served in Madras and Behar, he was appointed Assistant Engineer at Calcutta with the rank of Captain in the army. His work in the construction of Fort William was highly appreciated by all competent authorities. But as a non-Englishman, he found his way barred to promotion higher than Major. He, therefore, gladly accepted the offer of deputation with Nawab Shuja-ud-Daula of Oudh. But he soon became the victim of the hostilities of the enemies of Warren Hastings and had to resign his job in 1775. His straitened financial circumstances, however, compelled him to seek employment again and he was readmitted into the Company's service in April 1782 as a Lieutenant-Colonel and was stationed at Lucknow. In 1789 he finally retired from service, returned to Europe and settled down near Avignon in France. There he was murdered by robbers (or revolutionaries) on February 9, 1795.

Oudh in the eighteenth century was the land of art and literature and its capital, Lucknow, was the centre of educational and cultural institutions. Here Colonel Polier came into contact with men of learning and became interested in the history and religions of India. He collected quite a large number of Sanskrit, Persian and Arabic manuscripts and he was the first European to secure a complete set of the Vedas which, along with some Persian manuscripts, he presented to the British Museum, London. The Bibliotheque Nationale of Paris possesses a number of his

¹ Sarkar, *Fall of the Mughal Empire*, iii, 163-70; Ganda Singh, *Ahmad Shah Durrani*, 411; and *Calendar of Persian Correspondence*, v (No. 1843), 438.

manuscripts, and the Bibliotheque Cantonale of Lausanne, Vaud, Switzerland, 'contains a manuscript catalogue of 120 Oriental works with annotations by Polier'. The Khudabakhsh Oriental Public Library, Bankipore, Patna, is also said to have a manuscript bearing Polier's name-stamp. The Pote Collection at Eton College (England) was mainly made by him.

Polier was one of the earliest members of the Asiatic Society of Bengal, elected on January 29, 1784. He took quite a keen interest in the advancement of the object of the Society and, among other things, communicated to it a paper written by Dr. John Williams (read on February 9, 1787). His own paper on *The Siques or History of the Seeks* was read on December 20, 1787, and another on *The Distillation of Roses as Practised in Insin* and a *Translation of the Inscriptions on Pillars in Feroj Shah Kotla* were read on March 27, 1788. His *Mythologie des Indous* was published posthumously in 1809.

The above information about Colonel Polier is based on Dr. Pratul C. Gupta's *Introduction to Polier's Shah Allam II and His Court* (Calcutta, 1947), Hodson's *Officers of the Bengal Army* (Part III, L-R) and Buckland's *Dictionary of Indian Biography*. For further details, the inquisitive reader is referred to the *Secret and Public Consultations* in the National Archives of India, New Delhi, the National Archives' *Calendars of Persian Correspondence*, Davies' *Warren Hastings and Oude*, *Selections from the State Papers of the Governor-General of India* (Warren Hastings), *Bengal, Past and Present*, 1910, 1914, etc. etc.

Polier's paper on *The Siques* is evidently based on casual information collected by him during his deputation with Shuja-ud-Daula and the years following his resignation when he occasionally came into contact with them in the neighbourhood of Delhi and heard a good deal about them in connection with their relations with the Imperialists of Delhi and the Ruhilas, the Jats, the Rajputs and the Marathas. It contains a number of factual mistakes which are not uncommon to foreign writers of the late eighteenth and early nineteenth centuries when, for want of close personal contact, they did not have first-hand knowledge of the history and institutions of the Sikhs, nor, in the absence of authoritative literature and original documents, could they have reliable sources for their studies. Added to this, Polier had his own prejudices against the Sikhs impressed upon his mind by the repeated one-sided reports of the Mughal officials against whom they had been struggling for over eighty years. He, therefore, readily believed whatever information was given to him at the time he wrote his paper. All these I have tried to correct, in the footnotes, in the light of empirical knowledge and reliable material that have now become available.

I have also appended, under II and III, *An Extract from a Letter of Major Polier* written from Delhi on May 22, 1776, to Colonel Ironside at Belgram, and a note on the *Character of the Sieks* (from the observations of Colonel Polier and Mr. George Forster) culled from *The Asiatic Annual Register* for the year 1800 (London, 1801, pp. 32-35) and 1802 (London, 1803, pp. 9-12), respectively.

The letter to Colonel Ironside was written by Polier some eleven years before he read his paper, and the views and impressions expressed therein do not seem to have undergone much change. The writer of the *Character of the Sieks* seems to have studied the observations of both Colonel Polier and George Forster. Forster was a civil servant on the Madras establishment of the East India Company. He was a man of adventure and he left Calcutta on May 23, 1782, on his long and arduous overland journey to England and passed through the north-eastern hilly tracts of the Panjab in February, March and April, 1783. He was a keen observer of men and

things and he has recorded his impressions and the information collected during the journey in a series of letters published in 1798 under the title of *A Journey from Bengal to England*. Although, in his own words, Forster was under 'great obligations to Colonel Polier... for having furnished me with large historical tracts of the Siques', he had 'no tendency to discolour or misrepresent truth', as it appeared to him. 'Guided by no views of interest nor impressed by any frown of power, I was enabled', he says, 'to examine the objects that came before me through a dispassionate medium'. And he has succeeded in it to a very great extent. He has devoted his Letter XI, pp. 253-95, to the history and religion of the Sikhs, in addition to occasional references to them in other letters, *vide i*, 128-30, 198-99, 227-28 and *ii*, 83, 88.

The publication of this paper, along with the two appendices, will fill in an old gap in the records of the Asiatic Society and I am thankful to the authorities for having accepted to publish them.

I

THE SIQUES

The Siques date the origin of their sect as far back as the reign of Akbar, at which time lived in the environs of Lahore a reputed saint named *Gorou Nanak*.¹ (In their language, *Gorou* signifies master or leader, and *Sique* a disciple). This man had many followers, who embraced his doctrine, and acknowledged him as the head of a new sect, which, however, during that reign and the three succeeding ones did not increase much, or at least never attempted to rise against the lawful authority. It was not till the reign of Bahaudur Shah that they began to appear in arms² and endeavoured to shake off their allegiance, at which time under the direction of a new saint, one *Gorou Govind*,³ they laid the foundation of a kind of republic, which might prove very formidable to its neighbours, and overwhelm them in the end, did not at the same time their disunion, intestine divisions or jealousies prevent them from extending their power so far as they might otherwise.

Originally and in general the Siques are zemindars or cultivators of land, and of that tribe called *Jatts* which, in this part of India, are reckoned the best and most laborious tillers, though at the same time they are also noted for being of an unquiet and turbulent disposition. This tribe of the *Jatts*, one of the lowest amongst the Hindoos, is very numerous and dispersed in all the country from the *Attek* or the *Sind* to the southward far beyond *Agra*; and though in that extent, it be intermixed with some others, nevertheless, in those provinces, it is by far the most considerable tribe.

¹ The Sikhs trace their origin not to the days of the great Mughal Akbar, but to those of the Lodhis. Guru Nanak, the founder of the Sikh religion, was born in 1469 during the reign of the first Lodhi king, Bahlol Khan (1450-1488), and died in 1539 during the days of the second Mughal Emperor Humayun (1530-1540). *Sique*, *Siek* or *Sikh* is the Panjabi form of the Sanskrit *Shishya*, meaning a disciple.

² The first person to appear in arms was the sixth Guru Hargobind (1606-1644) during the reigns of Emperors Jehangir (1605-1627) and Shah Jahan (1627-1658).

³ Guru Gobind Singh, the tenth and the last Guru (1675-1708), instituted the baptismal rite, *Khandé dā Amrit*, on March 30, 1699, and created the order of baptized Sikhs or *Singhs*, known as the *Khalsa*, which became the basis of the Sikh republics (*misals*) established by the Sikh *Misaldar* Sardars.

The troubles and rebellions, which disturbed the empire during the tumultuous reign of *Bahadur Shah*, gave the Siques an opportunity of rising in arms, and shaking off the royal authority; this, however, they did by degrees; they fortified themselves at a place called *Ramrowny*,⁴ about 20 cosses this side of Lahore, and there established their principal place of worship, which is at a large tank called *Ambar Sar*,⁵ or *Chak*.⁶

The Siques then began to increase greatly in number, many proselytes were made, some from fear, others from a love of novelty and independence; all that came, though from the lowest and most abject castes, were received, contrary to the Hindoo customs, which admit of no change of caste, and even Musulmen were in the number of the converts. The fame of *Gorou Govind*,⁷ who then made his appearance and of whom many prodigies were related, contributed greatly to establish this sect. This reputed saint soon found himself at the head of a numerous force, and began to make excursions and converts, sword in hand. He exerted himself so successfully, that at last he drew the attention of Government towards him. Farockseer⁸ was then on the throne. An army was formed in or about 1715 under the command of Abdul Semad Khan Subadar of Lahore, and he had orders to exterminate the sect. It was not an easy task, however, after many marches and pursuits he came up with their main body, which he totally defeated. He had even the good luck to take *Gorou Govind*⁹ himself prisoner. The Gorou was sent to Delhi, shut up in an iron cage, and afterwards put to death,¹⁰ and his disciples, wherever they were caught, were, on their refusal of turning Mohammedans, immediately executed.¹¹ The chase became so hot after them, and was carried on with so much spirit, and so unrelenting a vigour, that the very name seemed extinct, and those few who still remained, were obliged by

⁴ Ramrowny is a compound of two words 'Rām' and 'rāonī'. *Rāoni* literally means an enclosure; and the walled enclosure raised by the Sikhs at Amritsar near their temple in April 1748 was named the Rām-Rāonī after the fourth Guru Rāmdās, the founder of Amritsar.

⁵ Amritsar, the principal place of Sikh worship, was not established at Rām-Rāonī, but, in fact, Rām-Rāonī was established near the Sikh place of worship at Amritsar (called Ambarsar by illiterate people) which had been founded by Guru Rāmdās in 1574, one hundred and seventy-four years before the Rām-Rāonī came into existence.

⁶ *Chak*, *Chak-Guru* or Chak Guru Rām-dās, was the original name of the city of Amritsar.

⁷ Here Colonel Polier, like many other writers before and after him, has confused Bandā Singh, a disciple of the Guru, with Guru Gobind Singh. Originally a *Bairāgi Sādhū*, Bandā Singh was converted to Sikhism by the Guru at Nander (Deccan) in September 1708, and was sent to the Panjab to lead the Sikhs in military expeditions. He arrived in the Panjab in 1709 and conquered the province of Sirhind in the battle of Chappar Chiri on May 12, 1710 (Rabi-ul-Awwal 24, 1122 A.H.).

⁸ It was during the reign of Emperor Bahadur Shah (1707-1712) that an army was first sent against Bandā Singh who had then to seek shelter in the Shavalik hills in December 1710. The campaign of Abdus-Samad Khan in 1715 during the reign of Farrukh-Siyar was the last one against Bandā Singh.

⁹ This was Bandā Singh and not Guru Gobind Singh. The latter died at Nander on October 7, 1708.

¹⁰ Bandā Singh was done to death at Delhi on June 9, 1716 (Jamadi-ul-Akhir 29, 1128 A.H.) near the shrine of Khwaja Qutab-ud-Din Bakhtiar Kaki.

¹¹ This evidently refers to the edicts issued by Emperor Bahadur Shah (1707-12) and Farrukh-Siyar (1713-19) ordering wholesale massacre of the Sikhs. In the fourth year of his reign (A.D. 1710), Bahadur Shah ordered *Bakhshi-ul-Mumalik* Mahabat Khan on Shawwl 29 (December 10) to write to the *faujdar*s of the territories of Shah-jahanabad to kill the Sikhs wherever found—*Nānak-prastān rā har-jā kih ba-yāband ba-qatl rasānand* (*Akhbār-i-Darbār-i-Muallā*). This order was repeated soon after the execution of Bandā Singh during the reign of Farrukh-Siyar saying: 'wherever found, the followers of this sect should be unhesitatingly killed' (*Miftāh-ut-Tawārīkh*, p. 598).

shaving off their beard, and hair, to deny their sect and leader.¹³ After him, for many years no more mention is made of the Siques, and it was not until some time after Nadir Shah's invasion that they began to show their head again. However, the gallant Mir Mannou, then Subadar of the provinces of Lahore and Multan, attacked them briskly, and gave them little time to get strength; indeed he might have crushed them entirely, had he not at the instigation of *Coraumul*, his Naib or Deputy in the Subadary of Multan, accepted a sum of money¹³ to save their capital Ramrowni which he had surrounded and was on the point of taking. This false step *Coraumul* engaged him to take to lessen the merit, it is said, of *Adina Beg Khan*, a brave and valiant officer (in whom Mir Mannou placed great confidence) who had conducted the expedition against the Siques, and who of course must have gained much glory had they been entirely reduced.¹⁴ However, from whatever motives it might be, the Siques escaped total destruction; they paid largely for it and Mir Mannou who had other work on his hand was no sooner at a distance, than they began to strengthen themselves anew. It is true, for some time and while *Coraumul* lived, they were by his influence over them kept in tolerable order and obliged to remain quiet, and moreover Mir Mannou's orders to convert them to Musulmanism or destroy them, wherever they could be found strolling in arms, were also during his life strictly and vigorously executed.

But the anarchy and confusion which ensued after Mir Mannou's death¹⁵ in the provinces of Lahore and Multan, from the different competitors for the Subadary, and the intrigues of his widow, who wanted to retain the Government in her hands and actually was for a considerable time in possession of it, prevented that attention from being paid to the Siques, which their spirit and rebellious principles required. It was then they began to grow formidable and to assume a real independence. They formed themselves into a kind of republic and in the course of a few years possessed themselves of the full Government of the province of Lahore and Multan.¹⁶

¹³ There is not a single instance on record to say that any Sikh during this period of persecution shaved off his head or beard or abjured his faith to save his life. The observations of the agents of the East India Company, John Surman and Edward Stephenson, in their letter XII of March 10, 1716, addressed to the President and Governor of Fort William and Council in Bengal, regarding the execution of about 780 Sikh companions of Bandā Singh at Delhi are very significant. The letter says: 'There are one hundred each day beheaded. It is not a little remarkable with what patience they undergo their fate, and to the last it has not been found that one has apostatized from the new formed religion.' (Wheeler, *Early Records of British India*, 180).

¹⁴ Kaura Mall helped the Sikhs during the governorship of Mir Mannu (April 1748 to November 1753) not for having 'accepted a sum of money', but because he was a Sikh himself, though not a baptized *Singh*. According to George Forster 'the preservation of the Siques from the effect of Meer Munno's success appears to have been largely promoted by the interference of his minister Korah Mul, who, being himself a Sique, naturally became a trusty advocate of the sect'. (*A Journey from Bengal to England*, Vol. I, 284-85; 272-73).

¹⁵ In fact the siege of Rām-Rāoni was raised in the interests of the government of Mir Mannu himself to secure neutrality of the Sikhs at a time when Ahmed Shah Durrani was invading India (in fact, the Panjab) for the second time in November 1748. As a result of the compromise, ten thousand Sikhs, under the leadership of Sardar Jassa Singh Ahluwalia, helped Kaurā Mall win the final battle (October 1749) against Shah Nawaz Khan in the conquest of the province of Multan. (Ganda Singh, *Mahārājā Kaurā Mall Bahādur*, 73-82).

¹⁶ Mir Mannu died on November 4, 1753 (Muharrum 7, 1167 A.H.).

¹⁷ Lahore was conquered by the Sikhs in April 1765 while Multan had been overrun by them in the summer of 1764. (Qazi Nur Muhammad, *Jang Nāmāh*, 38, 41; Ganda Singh, *Ahmad Shah Durrani*, 308-09).

About that time they attracted the notice of Ahmad Shah *Abdally*, the *Durany* king,¹⁷ whose Country extends to the River Attek, the northern boundary of the Subah of Lahore. Those Duranys are very strict Musulmen; though at the same time, perhaps, the most lawless bloody-minded barbarians on the face of the earth. They saw with rage the progress of the Siques and particularly the manner in which they proceeded towards the Islam or Mohammedan Religion.¹⁸ For the Siques not only destroyed the mosques and profaned the places of worship, but also compelled many Musulmen to embrace their sect, which boasts of violent hatred to that of Mohammed. The Siques besides had at different times, while *Ahmad Shah Abdally* passed through their country in his excursions towards Indostan, severely molested him in his marches, and never failed cutting off his straggling parties, and laying hold of every opportunity of distressing him. All those reasons engaged *Ahmed Shah* to think of chastising them in earnest. He was then, by having jointly with all the Mohammedan Amrahs of this part of Indostan defeated the Mahrattas¹⁹ and drove them away to the Deccan, at liberty to turn his arms towards them; accordingly he entered their country with a powerful army. The Siques were in no shape able to face him; they were defeated wherever they presented themselves, and pursued with all the violence and spirit of religious enthusiasm.²⁰ They were forced to fly with their effects, families and cattle into the jungles and impervious woods with which the country abounds and to abandon all the rest to the Duranys.²¹ They, however, still hovered round them at some distance with their cavalry and lost no opportunity of cutting off their stragglers and otherwise distressing them. *Ahmed Shah Abdally*, in the meantime, took their famous place of worship, which was immediately razed to the ground.²² The holy tank was filled up, and a price set on the Siques. Many pyramids were made of their heads, both at Lahore and other places, and in short it is certain that had *Ahmed Shah Abdally* remained three or four years in those parts, the sect would have been at an end

¹⁷ The Sikhs had attracted the attention of Ahmad Shah Durrani in January 1752 when the Shah invaded India for the third time. In March 1758 the Sikhs and the Marathas drove out of Sirhind the Durrani governor, Abdus-Samad Khan, and a month later, they occupied Lahore, driving out Timur Shah, the son of Ahmad Shah.

¹⁸ The Sikhs never entertained any enmity against Islam or Mohammedans as such. To begin with, they had to fight against the tyranny of the Mughal rulers who happened to be Mohammedans, and later on to free their country from the clutches of the Afghans—also Mohammedans—who invaded India and wished to annex the Panjab to their dominions. If, at any time, Muslim mosques came to be attacked by them, it was because they were the centres and headquarters of *Jehād* (religious war) against the Sikhs in those days. Otherwise, there are instances of the Sikh gurus and sardars building mosques for their Muslim friends and subjects. There might have been some cases, though very rare, of mosques having been desecrated in retaliation for the desecration or demolition of Sikh places of worship by Mohammedans.

¹⁹ This evidently refers to the battle of Panipat fought on January 14, 1761.

²⁰ This took place on February 5, 1762, when the Sikhs suffered a very heavy loss of over ten thousand lives in a day. This disastrous calamity is known among the Sikhs as *Waddā Ghalūghārā* or the Great Holocaust.

²¹ This sentence is suggestive of a saying common among the people of these days:

खाया पीया काहे दा
रहिदा बहिमद काहे दा

What we eat and drink is ours;
What remains belongs to Ahmad Shah.

²² This refers to the Sikh temple Darbār Sāhib at Amritsar, now known as the Golden Temple, which was blown up with gun-powder by Ahmad Shah Durrani on April 10, 1762.

though perhaps the country would have been depopulated by it, so very keen were the Duranies in their pursuit of them. Ahmed Shah, however desirous he might be to retain those fine provinces in his possession, could not, it seems, spare so much time to reduce them effectually. The vast extent of his dominions which extended from the Caspian Sea to the Gulf of Sind (and to which he had no other right but from his sword and good fortune), joined to his long absence from home, made it necessary for him to return to quell some revolts which threatened his upper provinces. He therefore contented himself with appointing different Governors to rule the country, and having left a garrison of 4,000 or 5,000 men in Lahore he recrossed the Attek and continued his march towards Belk where some chiefs had thrown off their allegiance. The Siques immediately began to avail themselves of his absence, which many circumstances rendered much longer than he at first intended. They rose in arms everywhere and fell on the Duranies on all sides. They surrounded Lahore and after some time obliged the garrison to surrender at discretion.²³ They now retorted amply on the Duranies. The mosques which had been rebuilt were demolished with every mark of indignity and washed with hog's blood. The Duranies were forced with their own hands to dig and restore the famous tank of *Ambar Sar*, which was soon brought to its ancient state and newly adorned with buildings. In short the Siques were now absolute masters, and having fully established their religion and national councils, they began to extend themselves to the southward and westward amongst their neighbours, most of whom they brought under contribution. From that time till *Ahmed Shah* Abdally's death,²⁴ which happened about eight or nine years ago, the Siques had several times to encounter with his forces, but Ahmed Shah never had it in his power to spare so much time as was necessary to reduce them completely, and was soon forced to relinquish that object.

Since his death and the accession of Timur Shah, his son, the Siques have been but little molested from that quarter. They have even been emboldened to take from him the city of Multan, which they possessed some time; though they have been forced to relinquish it lately,²⁴ they have nevertheless retained the greatest part of that Subah, and *Timur Shah* seems either too indolent, or too much employed at home, to think of beginning a contest with them in earnest.

Such has been the rise and progress of the Siques to this day which must be attributed, not so much to their bravery, conduct or military knowledge, as to the anarchy and confusion that has desolated the empire, one may say, for these 60 or 70 years past, that is, ever since the death of the great Aurangzeb but more particularly from the weak government during the reigns of *Mahomed Shah*, *Ahmed Shah*, and *Allumquir Sany*, the last of which may be cited as an example of the weakest and most wretched that ever was.

In their military capacity the Siques are far from being so formidable as they are generally represented, or as they might be. It is true they are in general exceedingly well mounted, that their horses and themselves

²³ Lahore was finally occupied by the Sikhs on April 16, 1765. Kabuli Mall was then the Governor of the province on behalf of Ahmad Shah and his nephew Amir Singh, in the absence of the Governor at Jammu, was compelled to surrender to the Sikhs.

²⁴ Ahmad Shah Durrani died on Rajjab 20, 1186 A.H., October 16-17, 1772. And Timur Shah conquered Multan from the Sikhs in February 1780. These references also help determine the date of the composition of this paper in the year 1780 as mentioned in footnote 25.

will undergo much fatigues, and perform very expeditious marches and that they have excellent matchlocks which carry a good way and which they manage on horse back with tolerable execution; all that must be allowed them and also that they are very abstemious and satisfied with what no other horsemen in India perhaps would put up with; but when it is considered in what disorderly manner they fight, that they know not what it is to be in close order, or to charge sword in hand and that they never could yet be brought to face the Durrannies, though 3 or 4 to 1,²⁵ it must be acknowledged that at best they are but the *Croates* of India, and indeed they resemble them very much in more than one point.

As for the Government of the Siques, it is properly an aristocracy, in which no pre-eminence is allowed except that which power and force naturally gives, otherwise all the chiefs, great or small, and even the poorest and most abject Siques, look on themselves as perfectly equal in all the public concerns and in the greatest Council or *Goormotta*²⁶ of the nation, held annually either at *Ambarsar*, *Lahore* or some other place. Everything is decided by the plurality of votes taken indifferently from all who choose to be present at it. In this Council or Diet all the public affairs are debated, such as alliances, wars and the excursions intended to be made in the ensuing year. The contributions collected in the last expeditions are also duly accounted for and distributed among the chiefs in proportion to their forces, who on their side must take care to satisfy their dependants in their full proportion, who would, was it otherwise, soon quit them and address themselves to others. The chiefs are extremely numerous and some of them have at their command as far as 10,000 or 12,000 horses; however, the generality are very inferior; many have only 15 or 20 horses, and from that number up to 1,000 or 2,000. It is computed that their whole force, if joined together, would amount to nearly 200,000 horses, a power which would be truly formidable did it act under one chief or one order. But divided as it is amongst 400 or 500 chiefs who all look on themselves as independent of each other, whose interests and views are almost all different, and perpetually jarring, it is much weakened thereby. It is true, in case of an invasion or foreign attack, they are bound to support one another as much as lays in their power, however, the spirit of independence is such that it is not without difficulty they can be prevailed on to act in concert, even for the public good. For in the war against *Ahmed Shah Abdally* it was but seldom that a greater force than 60,000 men could be brought together to oppose him; though certainly the occasion called for their most strenuous exertions; but in such times those only present themselves who have a great deal to lose. When out of their country, the Siques will indifferently fight for whoever pays them best, and their chiefs will engage some on each side of the question without the smallest hesitation or scruple. But when they are not retained in service, or are unemployed at home in disputes amongst themselves, they, particularly those on the borders, set off generally after the rains and make excursions in bodies of 10,000 horses or more on the neighbours. They plunder all they can

²⁵ Colonel Polier seems to have been misinformed about the military skill and prowess of the Sikhs. The inquisitive reader is referred to Qazi Nur Muhammad's *Jang Nāmāh* wherein the author has devoted section XLI to the 'Bravery of the Sikhs'. The Qazi had come to India along with the army of anti-Sikh Baluch crusaders during the seventh Indian invasion (1764-65) of Ahmad Shah Durrani and was an eye-witness of all that he has recorded in the *Jang Nāmāh*.

²⁶ *Gurmata* (*Gur-matā*) is, in fact, a resolution, a *matā*, passed in a council of the Sikhs in the presence of the *Gurū* (*Granth Sāhib*). It has at times been taken to mean a council (an assembly) of the Sikhs instead of a counsel.

lay their hands on, burn the towns and villages and do infinite mischief.²⁷ It is true they seldom kill in cold blood or make slaves; however, when they meet with handsome male children and robustly made, they carry them away and adopt them. The cattle is their principal aim; they carry them off in vast numbers and send them into their own country depriving by that means the wretched labourer and husbandman from the capacity of doing anything for himself afterwards. Thus they ruin and depopulate the finest provinces. To obviate those evils there is no other way except agreeing with one of their chiefs for a certain yearly tribute which they call *Rācky*,²⁸ in general a trifle will satisfy them, from two to five per cent on the revenues, particularly if at a distance; and provided this is regularly paid, it is said no further hindrance or molestation will be received from them. On the contrary the chief, to whom the tribute or *Rācky* is paid, takes the district under his protection and is ready to fight against any of brethren who might think of disturbing it. This method has been adopted by most of the zemindars bordering on them, who at the same time not to trust implicitly to the good faith of those freebooters have taken care to fortify their towns and put themselves on a defensive footing; without that, whole provinces would be a desert. The Siques possess an immediate tract of country, the whole soubah of Lahore, the greatest part of that of Multan and part of that of Delhi, including all the country called *Panjab*. They also carry their excursions through every part of the last soubah, and through part of that of Agra. Their own immediate possessions are exceedingly well cultivated, populous and rich; the revenues in general taken in kind throughout and not in money, which is very favourable to the tiller. In short few countries can vie with theirs, particularly in this part of India.

The Siques are in general strong and well made, accustomed from their infancy to the most laborious life and the hardest fare; they make marches and undergo fatigues that will appear really astonishing. In their excursions they carry no tents or baggage with them, except perhaps a small tent for the principal chief; the rest shelter themselves under a blanket which serves them also in the cold weather, to wrap themselves in and which in a march covers their saddles. They have mostly two horses apiece, and some three; their horses are middle sized, but exceedingly good, strong and high spirited, and mild tempered. The provinces of Lahore and Multan, noted for producing the best horses in Indostan, supply them amply and indeed they take the greatest care to increase their

²⁷ During their incursions the Sikh sardars attacked either the territories of the Mughal or of the Ruhilas. The object was to rob the Mughal rulers of their harmful political power and to so weaken them as to render them incapable of tyrannizing over their subjects, particularly the Sikhs themselves, who had suffered heavy persecution at their hands for about a hundred and fifty years beginning with the martyrdom of Guru Arjun in 1606, during the reign of Jehangir, to 1753 when a Mughal Governor of Lahore, Mir Mannu, sent out moving columns to exterminate them wherever found.

The Ruhilas to the east of the River Jamuna were the chief Indian allies of the Afghan invaders who were responsible for so much of misery brought upon the people of the Panjab. Their harassment by the Sikhs, therefore, indirectly contributed to the weakness of Ahmad Shah Durrani by distracting and diverting the support in men and munitions that would otherwise flow into the Afghan army to be more harmful to this country.

If the Sikhs had not incessantly carried on their struggle against the Mughals and hampered the progress of Afghan domination in northern India, the Panjab could not have been freed from under their crushing yokes.

²⁸ The word *Rācky* or *Rākhi* literally means protection, and was correctly applied to the tribute received by the Sikhs for the protection from external aggression guaranteed by them to the people paying it.

numbers by all means in their power; and though they make merry on the demise of one of their brethren,²⁹ they condole and lament the death of a horse, thus shewing their value for an animal so necessary to them in their excursions.

As for the food of the Siques, it is the coarsest, and such as the poorest people in Hindostan use from necessity. Bread baked in ashes, soaked afterwards in a mash made of different kinds of pulse, is their best dish, and such as they seldom indulge themselves with, except when, at full leisure; otherwise notches or grains hastily parched are all they care for. They abhor smoking of tobacco, for what reason I cannot find, but intoxicate themselves freely either with spirits or *bang*; a cup of the last they seldom fail taking at night after a fatigue. Their dress is extremely scanty, a pair of blue drawers, a kind of chequered plaid worn partly round the middle and partly over the shoulder with a mean blue turban forms all their equipage. Their chiefs are distinguished by having some heavy gold bracelets on their wrists and sometimes a chain of the same metal round their turbans and by being mounted on better horses, otherwise no distinction appears amongst them.

The sect of the Siques has a strong taint of the Gentoo³⁰ religion; they venerate the cow, and abstain piously from killing or feeding on it, and they also pay some respect to the *devtās* or idols. But their great object of worship is with them their own saints, or those whom they have honoured with the name of *Gorou*. Those they invoke continually, and they seem to look on them as everything. *Wah-Gorou* repeated several times is their only symbol, from which the Musulmen have (not without reason) taxed them with being downright atheists.³¹ Their mode of initiating their converts is by making them drink out of a pan in which the feet of those present have been washed,³² meaning by that, I presume, to abolish all those distinctions of caste which so much encumber the Gentoos; they also steep in it, particularly for a Musulman, the tusks or bones of a boar and add some of the blood of that animal to it. This with repeating the symbol to *Wah-Gorou*, wearing an iron bracelet on one arm and letting the hair of the head and beard grow, forms the whole mystery of their religion, if such a filthy beastly ceremony can be dignified with that name.³³

²⁹ The Sikhs do not make merry on the occasion of the death of a Sikh but they accept it as the Will of God and recite hymns from their scripture, the *Gurū Granth Sāhib*, in resignation to it. 'Having been sent by him they come (into the world) and recalled by Him they go back,' says Guru Nanak. 'It is the right and privilege of the brave to die, if they die in an approved cause,' says he.

³⁰ Corrupt form of Hindu, derisively used. The Sikhs have no belief in gods and goddesses (*devtās* and *devis*), nor do they venerate the cow, as mentioned in the text.

³¹ In calling the Sikhs atheists, Polier is writing his impressions on second-hand information given to him by those who seem to have purposely misrepresented the Sikh religion to him. The fact that they repeat *Wāhigurū* (*Wāh-Gorou*), the name of God, is enough to prove them to be theists. The Sikhs are staunch believers in the existence and fatherhood of God who, according to them, is Self-existent, Omniscient and Omnipresent and is the Creator of the universe.

³² The ceremony of initiation is also misrepresented. In fact, it is clean water, mixed with sugar and stirred in a pure iron pan with a double-edged dagger, with hymns from Sikh scriptures recited over it, that is given to the initiates to drink as a part of the ceremony. This is called *Khandé dā Amrit* or nectar of the double-edged sword.

³³ Nothing of this kind was done in the case of Muslims converted to Sikhism. To say that the tusk or bone of a boar was steeped in the consecrated water (*Khandé dā Amrit*) or that some blood of that animal was added to it particularly for Muslim converts to Sikh faith is nothing but an imaginary fib of the informants of Col. Polier. It is not improbable that Polier himself had also his own prejudices against the Sikhs which have marred the objectivity of his study presented in this paper.

They have also stated pilgrimages both to the Ganges³⁴ and their famous tank at *Ambarsar* where at fixed times they wash and perform some trifling ceremonies, invoking at the same time their *Gorou*.

Such are the Siques, the terror and plague of this part of India, a nation and power well calculated for doing mischief and encouraging rebellion in the *zamindars* or cultivators, who often follow their steps at first with a view of saving themselves and afterwards from the pleasure of independence, and indeed it is that which makes them so troublesome, for they begin to have connections in almost all the parts they visit on their excursions, and if they are not attacked soon in their own proper provinces, it is much to be feared their tenets and manners will be adopted by all the *zamindars* of the *soubah* of *Delhi*, and part of *Agra*. It is, however, imagined that so soon as *Najhaf Khan* is clear of the *Matchery Rajah*,³⁵ he means to turn all his forces towards the Siques, and at least to drive them from this side of *Sirhind*, which he may I think easily do, though perhaps it would not be safe for him to go farther, except *Timur Shah* should on his side attack them also across the *Attek*, then indeed and by remaining a few years in the centre of their country they might be effectually reduced. The Siques make no account of infantry except for the defence of their forts, and have no artillery; their rapid motions will not allow of their having any with them, though they are not ignorant of the effect of it, when well served, which they take care to avoid as much as possible. I have nothing more to add to this account except a pretended prophecy, which the Siques say has been delivered down by some of their *Gorou*, that the Siques after remaining sometime the terror of India would at last be finally destroyed by white men coming from the westward. Who are to be those white men, time must discover, but the Siques themselves think the Europeans will fulfil the prophecy,³⁶ and are meant by it.

³⁴ The Sikhs do not hold the Ganges or any other river as sacred, nor is it a place of pilgrimage for them.

³⁵ This reference to the campaign of *Mirza Najaf Khan*, the Mughal *Mir Bakhshi*, then going on against *Rao Raja Partap Singh* of *Macheri*, read along with footnote No. 24, determines the date of the writing of this paper as 1780 A.D.

³⁶ A prophecy of this type in a slightly different form, predicting the coming of Europeans, is ascribed to *Gurū Tegh Bahādur*, who is said to have told *Emperor Aurangzeb* in 1675 in answer to the charge of looking in the direction of *Imperial zanana*: 'I was looking in the direction of the Europeans who are coming from beyond the seas to tear down thy *pardas* and destroy thine empire.' (*Macauliffe, Sikh Religion*, Preface, XVIII).

In the prophecy mentioned by *Polier* in 1780 in the text above, the object of destruction has been changed from the Mughal empire to the power of Sikhs. The change has evidently been made by some well-wisher of the decaying Mughal empire and an enemy of the rising power of the Sikhs.

The prophecy recorded by *Macauliffe* was ascribed by some people to the fertile imagination of some clever Englishman during the mutiny of 1857 to win the sympathy and support of the Sikhs against the protagonists of Mughal rule in India. But the reference to the prophecy in this paper written seventy-seven years before the mutiny is rather intriguing. It, however, explodes the above theory.

II

THE SIKHS

Extract from a letter from Major Polier at Delhi to Colonel Ironside at Belgram, May 22, 1776.

The king's dominions are bounded on the north, NW. and WNW. by the Siques: to the NE. and within the Doab Zabita Chan possesses a large tract of country which heretofore belonged to the king, but is now, by the late treaty, finally made over to him.

As for the Seikhs, that formidable aristocratic republick, I may safely say, it is only so to a weak defenceless state, such as this is. It is properly the snake with many heads. Each zemindar who from the Attock¹ to Hansey Issar,² and to the gates of Delhi, lets his beard grow, cries *Wah gorow*,³ eats pork,⁴ wears an iron bracelet, drinks bang, abominates the smoking of tobacco and can command from ten followers on horseback to upwards, sets up immediately for a Seik Sirdar, and as far as is in his power aggrandizes himself at the expense of his weaker neighbours; if Hindu or Mussulman so much the better; if not, even amongst his own fraternity will he seek to extend his influence and power; only with this difference, in their intestine divisions, from what is seen everywhere else, that the husbandman and labourer, in their own districts, are perfectly safe and unmolested, let what will happen round about them.

From this small sketch it may be easily conceived that the Seiks are much less formidable than they are represented. It is true that they join together when invaded as was the case when Abdallah⁵ passed through their country. But notwithstanding they had assembled an immense body of cavalry, extremely well mounted, yet they never presumed to make a single charge on the Durrany army, or even on detachments; and considering their irregularity and want of discipline and subordination, it was well for them, I think, they did not. They satisfied themselves in making a kind of hussar⁶ war of it, cutting off stragglers and intercepting provisions. In this they excel. To say the truth, they are indefatigable, mounted on the best horses that India can afford, each carries a matchlock of a large bore, which they handle dexterously enough, and with which they annoy considerably, avoiding, at the same time, going in large bodies or approaching too near. Such is their way of making war, which can only appear dangerous to the wretched Hindustani troops of these quarters, who tremble as much at the name of a Seik, as people used to do, not long ago, at the mention of Mahrattas. But what is more to be admired is that those Seik Sirdars, whose territories border on the King's, were but very lately of the Jauts and of their caste and tribe, under which domination had they

¹ Attock or Atak is the local name of the river Indus (Sindh) in the north-western frontier province of Pakistan. There is also a town with a fort of the same name on the eastern bank of the river at a point where the Grand Trunk Road crosses it.

² Hansi, Hissar.

³ *Wah-Gorow*, or *Wahiguru*, a name of God, meaning the Wonderful Lord.

⁴ Eating of pork or any other kind of meat is not particularly encouraged amongst the Sikhs, much less considered an essential part of the Sikh diet. The use of *bhang* prevalent amongst the majority of *Nihang* Sikhs is positively looked down upon as undesirable.

⁵ Ahmad Shah Abdali or Durrani.

⁶ Light cavalry.

remained, no one would have thought of them; but now that they have put on their iron bracelet, fifty of them are enough to keep at bay a whole battalion of the King's forces, such as they are. This shows the force of prejudice and the value of military reputation. Such are the immediate neighbours of the King.

Five hundred of Nujhaf Khan's horse dare not encounter fifty Seik horsemen; and yet the last are as despicable a set of creatures as any that can be imagined! On the whole, was it not for Sombre's party, and Letafet's forces, Nujhaf Khan would not be able to stand his ground half an hour; and yet this is The Mighty Chief!

III

A CHARACTER OF THE SIEKS

(From the observations of Colonel Polier and Mr. George Forster)

The Sieks are in general strong and well made; accustomed from their infancy to the most laborious life and hardest fare, they make marches and undergo fatigue that really appear astonishing. In their excursions they carry no tents or luggage, except perhaps a small tent for the principal officer; the rest shelter themselves under blankets which serve them also in cold weather to wrap themselves in, and which, on a march, cover their saddles. They have commonly two, some of them three, horses each, of the middle size, strong, active and mild tempered. The provinces of Lahore and Moultan, noted for a breed of the best horses in Hindustan, afford them an ample supply; and indeed they take great care to increase it by all means in their power. Though they make merry on the demise of any of their brethren,¹ they mourn for the death of a horse, thus showing their love of an animal so necessary to them in their professional capacity. The food of the Sieks is of the coarsest kind, and such as the poorest people in Hindustan use from necessity. Bread baked in ashes, and soaked in a mash made of different sorts of pulse, is the best dish, and such as they never indulge in but when at full leisure; otherwise vetches and tares, hastily parched, is all they care for. They abhor smoking tobacco, for what reasons I cannot discover, but intoxicate themselves freely with spirits of their own country manufacture: a cup of the last they never fail taking after a fatigue at night. Their dress is extremely scanty; a pair of long blue drawers,² and a kind of chequered plaid, a part of which is fastened round the waist, and the other thrown over the shoulder, with a mean turban, form their clothing and equipage. The chiefs are distinguished by wearing some heavy gold bracelets³ on their wrists and sometimes a chain of the same metal bound round their turbans, and by being mounted on better horses; otherwise no distinction appears amongst them. The chiefs are numerous, some of whom have the command of ten or twelve thousand cavalry; but this power is confined to a small number, the inferior officers maintaining from one to two thousand, and many not more than twenty or thirty horses, a certain quota of which is furnished by the chiefs, the greater part being the individual property of the horseman.

¹ See footnote 29 in I.

² Called *Kachhā* or *Kachhehrā* (ਕਚਿਹਰਾ).

³ Called *Kapā* (ਕਪਾ) worn on festive occasions in many parts of the Panjab up to the beginning of the twentieth century.

From the spirit of independence so invariably infused amongst them their mutual jealousy and rapacious roving temper, the Sieks at this day are seldom seen co-operating in national concert; but actuated by the influence of an individual ambition or private distrust, they pursue such plans only as coincide with these motives. An example of their forces being engaged in opposite interests has been noticed in the case of Maha Singh, who succoured the Rajah of Jumbo against the Siek party who had invaded his country. Before the chiefs of the mountaineers' country at the head of the Panjab were reduced to a tributary state, severe depredations were committed on them by the Sieks who plundered and destroyed their habitations, carried off the cattle, and, if strong and well formed, the male children, who were made converts to the faith of Nanock. But since the payment of a fixed tribute has been stipulated, which does not amount to more than five per cent of the revenue, the mountaineers are little molested, except when the Sieks have been called upon to adjust their domestic quarrels.

The extensive and fertile territories of the Sieks, and their attachment and application, in the midst of warfare, to the occupations of agriculture, must evidently produce a large revenue. The district dependent on Lahore, in the reign of Aurangzeb, produced, according to Mr. Bernier, a revenue of two hundred forty-six lacks and ninety-five thousand rupees; and we are naturally led to suppose, from the industrious skill of the Sieks in the various branches of cultivation, that no great decrease of that amount can have taken place since the Panjab has fallen into their possession.

An extensive and valuable commerce is also maintained in their country, which has been extended to distant quarters of India, particularly to the provinces of Bengal and Behar, where many Siek merchants of opulence at this time reside. The Omichand, who took so active, though unfortunate, a share in the revolution which the English effected in Bengal, was a Siek, as is his adopted son, who is now an inhabitant of Calcutta. Merchants of every nation or sect, who may introduce a traffic into their territories, or are established under their government, experience a full protection and enjoy commercial privileges in common with their own subjects. All the same, it must be noticed that such immunities are granted only to those who remain amongst them or import wares for the immediate supply of the Siek markets. But the foreign traders, even travellers, who attempt to pass through the Panjab, are often plundered and usually ill-treated;⁴ in the event of no molestations being offered to people of this description, the escape is ever spoken of with a degree of joyful surprise, and a thanks-giving is offered to Providence for the singular escape. This conduct, inimical to the progress of civilization and an impediment to the influx of wealth, proceeds from an extreme jealousy of strangers, added to a rapacity of temper, which make them averse to the encouragement of any scheme in whose success they do not immediately participate.

The Sieks are not rigorous in their stipulation with the Mohammedan proselytes, who if they abstain from beef's flesh (which is held in equal abhorrence by the Sieks as by the Hindus), and perform the more ostensible duties, as burning their dead, and preserving the hair of the head, an

⁴ Grant of full protection and commercial privileges to merchants of every nation or sect as mentioned in the text above is not reconcilable with the alleged plunder and ill-treatment of foreign traders passing through the Panjab. The plunder of foreign traders by some lawless marauders in a few rare cases in those unsettled days is not improbable, but that could not be generalized,

indulgent latitude is granted in all other articles of the creed of Nanock.⁵ The Mohammedans who reside in the Panjab are subject to occasional oppression, and often to the insults of the lower classes of the people; amongst whom it is an uncommon practice to defile the places of worship by throwing in the carcasses of hogs and other things held impure by the Mussulman law. The Mohammedans are also prohibited from announcing their stated time of prayer, which conformably to their usage, is proclaimed in a loud tone of voice. A Siek, who in the chase shall have slain a wild hog, is frequently known to compel the first Mohammedan to meet to carry to his home the body of the animal; and, on being initiated into the rites of their religion, the Sieks will sometimes require Mohammedan convert to bind on his arm the tusk of a bore,⁶ that by this act of national impurity he may more avowedly testify a renunciation and contempt of his former faith. The facts sufficiently mark the haughty and insulting demeanour, which, with few deviations, forms a prominent feature in the character of the military Sieks: but we may also ascribe a certain portion of their severe and contumelious treatment of Mohammedans to a remembrance of recent injuries.

The discordant interests which agitate the Siek nation, and the constitutional genius of the people, must incapacitate them, during the existence of these causes, from becoming a formidable defensive power; nor are they invested with that species of executive strength which is necessary to advance and establish a distant conquest. In the defence and recovery of their country the Sieks displayed a courage of the most obstinate kind, and manifested a perseverance, under the pressure of calamities, which bear an ample testimony of native resource, when the common danger had roused them to action, and gave but one impulse to their spirit. Should any future cause call forth the combined efforts of the Sieks to maintain the existence of empire and religion, we may see some ambitious chief, led on by his genius and success, and, absorbing the power of his associates, display from the ruins of their commonwealth the standard of monarchy. The page of history is filled with the like effects, springing from like causes. Under such a form of Government, I have little hesitation in saying that the Sieks would be soon advanced to the first rank amongst the native princes of Hindustan and would become a terror of the surrounding states.⁷

⁵ Rules of Sikh conduct, called the *Rahit* (ਰਹਿਤ), in their terminology, are the same for all Sikhs and are applicable to all converts whether from amongst the Hindus or Mohammedans.

⁶ The suppression or ill-treatment of Muslims seems to have been very much exaggerated and may be taken as based on wrongful information given to him by his prejudiced informants. Colonel Polier himself also seems to have been considerably influenced by the anti-Sikh propaganda of the then interested parties.

⁷ This prophecy of George Forster came to be fulfilled in the person of Maharaja Ranjit Singh (1780-1839) who created a monarchy, benevolent and republican in its character, out of the various Sikh Misals and Muslim States of the Panjab towards the end of the eighteenth century. (Cf. George Forster, *A Journey from Bengal to England*, i. 295).

INDIA AND CHINA : ANCIENT CONTACTS¹

WHAT INDIA RECEIVED FROM CHINA

By SUNITI KUMAR CHATTERJI

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INDIA AND CHINA : AGREEMENTS AND CONTRASTS

India and China are two of the greatest countries of Asia and the world, from various aspects. In point of population, they are the first two countries of the world, China with her 650 millions (including not only the Han or Chinese people proper, but also certain 'autonomous nationalities' which are now within the orbit of the Communistic People's Republic of China, like the Turki-speaking peoples of Sin-Kiang, the Tibetans, and quite a number of other minor peoples), and India with her 340 millions (we should consider the fact that although politically India and Pakistan are separate countries, they nevertheless form a single geographical and cultural unit; and taking India and Pakistan together as one unit, although divided politically, the total population of the sub-continent of Undivided India would be some 420 millions). In extent, India is not so big as China, but in other matters there are common points for their pre-eminence in the world. Of course, the Soviet Union and America also are very vast countries, but in population they come after China and India. Besides, the United Kingdom, Germany, Japan and France are not very big countries and do not have any remarkably large population (excepting for Germany and Japan, each with its 90 millions). But these countries have been in the forefront of modern civilization and progress, and were possessed of or are still holding vast empires. Therefore they command a very great deal of importance in the international domain.

China and India are both very ancient countries, and the civilization and way of life, which was built up by them, has endured for millennia. The Chinese civilization and way of life is something unique, and so is the Indian one. There are certain fundamental differences in the background of both China and India, but there are also some very deep points of agreement as well. The people of China on the whole form a single racial unit with its various branches—they belong to the great *Mongol* race. There is thus a basic homogeneity in the people of China. But in India, there is no such homogeneity. India has been, since very early times, a melting-pot for different races and cultures. Instead of a single type of people giving the base to the present population of India, we have at least four distinct races with their different languages and cultures, who, by a very close miscegenation, gave rise to the Common Indian Type over 3,000 years ago. The following racial elements have contributed to the formation of the people of India, apart from a very early black *Negroid* people who appear to have been either absorbed or killed off by the subsequent in-comers. We have to consider first the dark *Austriac* people, who appear

¹ Paper read by the Author before the Joint Session of the Indian Sub-Sections of the 25th International Congress of Orientalists in Moscow, U.S.S.R., on August 9, 1960.

to have contributed the vast majority among the masses of the country—the Austric people are also found in Burma and Indo-China and Indonesia, and in this way one of the racial components of the Indian people has got a genetic connexion with the peoples of Indo-China and South-East Asia and of Indonesia. The next element in the Indian population was furnished by the *Mongol* peoples, who were golden or yellow in colour and had their special physical characteristics. Along the Himalayan slopes, in Assam, in East and North Bengal and other parts of North India, the Mongoloid element was to be found. In ancient times, before it fused with the other elements, there is evidence that this Mongoloid element also trickled down to Rajasthan and Central India. The third element, which is one of the most important constituents of the Indian population, is the *Dravidian*. They are a brown people originally from the East Mediterranean area, and they gave some of the basic components for the culture of India, along with the Austrians. Finally, we have the white *Indo-Aryans*, who were probably the latest comers in the field. These Indo-Aryans brought a very powerful social organization, and they gave the final tone and discipline to a composite civilization which grew up on the soil of India; and their language, which was Vedic Sanskrit in ancient times, was a very great contribution of theirs. Through this language, India is linked up mentally and spiritually with the world of Europe.

In this way, we have a mixture or fusion of at least four main races: the dark Austrians, the yellow Mongols, the brown Dravidians and the white Aryans; and this fusion brought about the creation of the *Indian Man*, some 3,000 years ago and more. There were other racial elements from outside, but they have all become assimilated. A great contrast between China and India in this matter therefore is this—that China is essentially Mongol, whereas India is a fusion of Aryan and Dravidian, Austric and Mongol. In the development of culture and mentality, this fact has been effective in shaping the orientation of the Chinese and Indian minds. The Chinese mind is practical and factual and pragmatic, and it has a very vivid sense of actualities. Its historic sense is something unique. The Indian mind is thoughtful and speculative, and at the same time emotional. In order to make fully effective the fusion of races, which is at its base, it could not but neglect factual and political history; and it developed a sense of accommodation and acceptance rather than rejection and intolerance. Rejection and intolerance are of course not to be found in China, at least in a pronounced or aggressive form, because the Chinese mind was from very early times moulded by the philosophy of the *Tao*, which sought to look into the basic Unity behind life, almost as much as the Indian mind. Then, the mind of India influenced tremendously that of China through Buddhism. China also appears to have influenced (but only at a later period) some aspects of the Indian way of thinking as well.

Although outwardly there are vast differences in appearance and in personal habits as well as corporate behaviour, the economy of these two countries is basically agricultural. The common characteristics of an agricultural economy and agricultural civilization are to be found in both India and China. Certain social values are common to both the countries; and the most fundamental of these has been the solidarity of the family. The relationship between the head of the family and the dependents—of the father with the sons and daughters, of the husband with the wife, and similar relationships among the various members of a family unit whether they are connected by blood or not, are regulated by a fixed code of usage which is very similar for both India and China. India is more religiously-minded than China, and India is more philosophical in her attitude. But

there is no lack of deep religiosity in the mind of China also. The present Communist set-up in China with its new ideologies is unquestionably bringing about some very remarkable changes in the Chinese way of life, just as the forces of a new Individualism and of a new Economy are doing the same thing to the traditional Indian way of life. But it will take some time before the basic things are altered and the basic values are abandoned. There is a wonderful resilience in the Chinese mind and in Chinese society, as much as in the Indian; and it will have to be seen how far it can maintain its old sense of values in a changing new world.

The peoples of China and India have been neighbours for at least 4,000 years, and in the earlier stages of their history they were isolated from each other. But both India and China appear to have developed independently some conceptions about the World and Being and the Ultimate Reality, which have a strange family resemblance. Thus, for example, the Philosophy of Taoism in its transcendental aspect, and that of the Upanishads, which are unquestionably independent contributions of the countries of China and India, have some very great resemblances. Similar conceptions are found among other peoples far away from India and China, like, for example, the True Africans (Black Africans), and the Polynesians. These would appear to be certain ideas which were arrived at independently by various sections of Humanity in different times and in different climes, and they would suggest a sort of a universal reaction in the human consciousness with regard to the World of Being. Thus in China there is the Philosophy of *Tao*,* which is Cosmic Order and Unseen Root of all things; and this can be compared with the Indian Philosophy of the Supreme Spirit (*Para-Brahman*) which is conceived of as Cosmic Order (*Rita*), as well as Moral Order (*Dharma*): and this *Para-Brahman* is both transcendent and immanent in this universe (*kāṭa-v-ul*, as the idea is expressed in Tamil). *Tao* is also the Unseen Reality behind life which is equally a Cosmic Order, and it expresses itself in *Teh* or Virtue or the essential character of the thing, like the Indian conception of *Dharma*. The unmanifested *Para-Brahman* or *Tao*—which may be called the Absolute in its own Nature—manifests itself through the various categories, including the various Divinities, which in later imagination are connected with the different spheres of nature and man's material, moral and spiritual life. The Africans similarly have a faith in an Ultimate Force which is working through the Universe, and this Force also in their conception manifests itself in the various Gods and Spirits to whom Man addresses himself. The Polynesians have a similar conception of *Mana* or Innate Force or Virtue or Principle which is operating in everything. These basic things apart, there are certain other points in which the Chinese and the Indian approaches to existence appear to agree, although there are notable points of divergence as well.

CONNEXION BETWEEN INDIA AND CHINA THROUGH BUDDHISM, AND THROUGH SINOLOGICAL AND INDOLOGICAL STUDIES

This basic agreement between India and China was to a large extent responsible for Mahāyāna Buddhism being easily accepted by China from the early centuries after Christ and absorbing it in the fabric of China's own native culture. China and India first appear to have come to know each other indirectly, without any actual contact, during the centuries

* *Dhau* in Ancient Chinese pronunciation.

immediately before Christ. We do not have any evidence of an earlier knowledge or contact between India and China. From the time of Christ right down to about 1,200 years later, for a whole millennium and more, India and China knew each other fairly well, and in this matter the advantage was always more on the side of China, because Chinese travellers and pilgrims used to come to India and return home, whereas Indian scholars who went to China mostly stayed on there. There was therefore greater knowledge about India in China than about China in India.* This contact was particularly close during the first 800 years after the birth of Christ. Gradually India and China with their domestic troubles were cut off from each other—the invasion of India by the Arabs (early eighth century), when they conquered Sindh, and then by the Turks (from the tenth century onwards), and finally early in the thirteenth century the Turks established a Muslim Empire in North India; and the terrible blow suffered by the Indian people in this struggle with Islamized Arabs, Turks and Iranians forced them to abandon their international contacts in Eastern and South-Eastern Asia and in Indonesia. China, after the Sung period, came under the domination of the Tatars, and her earlier enterprise in this matter similarly suffered a check. They almost forgot each other, though in China the presence of Buddhism kept up the memory of India in the mind of China, and also in the life of China. In India, China came to be known as *Mahā-Cīna* or Great-China, and was known as a great country to the North-East of India, and that was all. Of course, certain articles were received from China by India, like vermilion and silk and pottery. But then it was mainly through Muslim traders by the sea, from the beginning of the second millennium A.D.

The interest which the European Man felt in the Man of Asia, as a direct result of the working of Greek Humanism on the mind of cultured Europe (from the days of the Renaissance in the fifteenth and sixteenth centuries, and particularly in the eighteenth century), made European scholars take to the study of the past of India and China. The European Sinologues or students of Chinese things, beginning with the Roman Catholic Jesuits in China in the seventeenth century, discovered the early literature and culture of China. When they began to read Confucius and the early Chinese Classics in the original in the middle of the nineteenth century, the history of the contact between India and China in ancient times was discovered by European scholars of Chinese in France, England and Germany, by their study of the old records left by the Chinese Buddhist pilgrims and scholars themselves. Side by side with Confucius and Mencius, Laocius (Lao-tzū) and Chuang-tzū and the early poets and historians, the writings of Fa-Hsien and Hsuan-Chuang and Yi-Ching gave to the European Savants glimpses of a new world, and opened up the lost story of intellectual and spiritual, artistic and scientific co-operation between India and China in those far-off centuries. The story of this contact between India and China came also to India through English and other European languages. The intellectuals of modern India discovered China as an ancient friend and fellow-traveller in the same quest for Truth: and the Indian intelligentsia received this discovery with enthusiasm, and opened out their heart in friendship for China. Similarly, in China, scholars trained in the European tradition, and the old-fashioned Chinese Buddhist and other scholars, both had their attention drawn to all this wealth of historical information preserved in their own literature; and they, too, discovered once again in the modern age their old friend India. The study of this Sino-Indian contact was pursued in India as a part of Indian and Asian History.

But there was a great draw-back that all this study was done by Indian scholars only second-hand, through materials made accessible to them by the scholars of Europe. The first Indian scholar at the present age, who by learning Chinese from his great French Master Sylvian Lévi put to use original Chinese documents and wrote a number of first-rate works on this subject (which formed the first scientific contribution of an Indian Sinologue to the topic), was the late Prabodh Chandra Bagchi, Vice-Chancellor of Visva-Bharati University, whose untimely death has been such an irreparable loss to Sino-Indian scholarship. In India, the initiative, which was taken by Sir Asutosh Mookerjee in the University of Calcutta and then by Rabindranath Tagore in the University of Visva-Bharati to inaugurate Chinese studies, has been taken up by the National Government of India; and Indian scholars are being sent to China to study the language, to obtain first-hand information about the history and civilization of China, and to work out, among other things, the problems of Indo-Chinese cultural contacts.

The Chinese Buddhists from very ancient times had a great love and respect for India as the land of the Buddha. Buddha's personality—the profound trends of his thinking, as well as his all-embracing love of man and of all living creatures—had made a very great impression on his contemporaries. His life and his doctrines became for one half of Humanity a great source of inspiration. The loving reverence with which he was looked upon by his followers not only in India but also outside India, the devotion which his personality evoked, is something unique, and it is comparable to the love and reverence for Christ which we find in Christian communities. Chinese Buddhists have given ample evidence of the lines in which, through the intermediacy of Buddhism, Indian civilization and Indian thought worked on the mind of China. The Chinese have received Buddhism and with it Buddhist philosophy and certain Buddhistic values like *Ahimsā*, *Karuṇā* and *Maitrī* (non-injury, charity and active good-doing) from Buddhism; with Buddhism also came some abstruse systems of thought, the like of which was not known in pre-Buddhist China. The Indian system of writing created a profound impression on the Chinese mind, as in their script the Chinese did not lay any considerable value on the *sounds* of the spoken word; they were busy in representing *objects* and *ideas* by means of elaborate and arbitrary (though very cleverly conceived) symbols. The phonetic study of their language for the first time started among the scholars of China with their knowledge of the Indian system of writing with its phonetic basis. This was a very great advance in linguistic study in China. Although China did not abandon her native system of pictograms, indeograms and phonograms, a new world was opened up in linguistics to the learned men of China in this way. Indian medicine and Indian astronomy also had some influence in China. Quite a number of new literary *genres* or types as well as styles came to the knowledge of Chinese writers and scholars through Indian literature which began to be translated into Chinese. Certain Indian Buddhist and other conceptions became so very much embedded in the Chinese consciousness that this brought about a very great spiritual *rapprochement* between the people of India and the people of China. The Chinese quite early made Buddhism and Buddhist ideas and rituals so much a part of their life that one can say at the present day in China the national religion of China (what remains outside of the present-day Communist sphere of influence) is a chemical compound or amalgam of Taoism, Confucianism and Buddhism. In his social life and behaviour as a normal cultured individual, an educated man is a Confucianist. In some of his mystic approach to the Unseen

Reality, he is a Taoist; and in his deeper philosophy of life, as well as in the ritual which is followed in death, he is a Buddhist. In following popular cults and practices and worship of the Gods, he is a Taoist and a Buddhist combined into one. In this way, a new tone was given to Chinese life through Indian contact. In the outward expressions of life, we note that in the arts, both the higher arts and in the artistic crafts, there was a good deal of influence from India on China. A new branch of Chinese Art, and one of the profoundest in its expression of the ideal, came into being—Buddhist-Chinese Art. China's great contribution in literature and in the pictorial art was in her reaction to Nature. China's Nature Poetry is one of the most delicate and most artistic expressions of human sensibility; and Chinese landscapes and studies of Nature are unequalled in their realism, and in their profundity as well as in their sublimity. In this matter, certain schools of Buddhism have given a considerable amount of impetus to the artistic soul of China—in this love of Nature, and of the life of the recluse dedicated to meditation, as they were reflected in literature as well as pictorial art.

The great debt of China to India was tacitly accepted by China, and India also felt quite glorified at having a *kalyāṇa-mitra* or 'Friend in the Quest for the Good' in China. In certain Indian quarters, which were not very informed or circumspect, there has developed at the present day also a feeling of pride for this, and this might be with charity regarded as pardonable pride, when through ignorance it does not go dangerously near Chauvinism.

INDIA-CHINA CULTURAL INFLUENCES NOT A ONE-WAY TRAFFIC : CHINESE INFLUENCES ON THE MIND OF INDIA

If China received so much from India, one might also ask—what did India receive from China? Of course, we have a list of material objects which we received from China in very early days: like silk stuffs, like bamboo flutes, like vermilion, like paper, and some fruits like the peach and the pear, and a few other things. But these material objects do not prove anything. When two great peoples meet, we would expect them to influence each other, not by an exchange of the world's goods merely, through trade or barter, but by exchange of ideas, of intellectual and spiritual ideas and values in the higher plane. China had unquestionably one of the greatest civilizations of the world. India and China were at the apogee of their civilizations during the greater part of the first thousand years after Christ. Some of the finest intellects of China came to India and made their prolonged sojourn at a time when India had her intellectual powers at their highest. And out of curiosity and interest in other peoples, some of the best intellects of India, again, went to China, to learn the Chinese language and help the Chinese people in translating into their language Indian religious and philosophical works. They also carried their ideas to China—in literature and in the fine arts and in whatever sciences they knew in those days. If India could not receive some of her mental pabulum from China, that would only show an intellectual poverty and want of receptivity among the Indians. The question naturally would arise—was this long period of contact between India and China, which was so fruitful in China, merely a one-way traffic? Could not India also take, as she gave?

This is a matter which did not so far seem to exercise the minds of those who were concerned in the study of India-China cultural contacts.

The great fact of China being largely the debtor was admitted, and it was very rarely seriously considered whether China was able to pay back to India some of her debts in similar intellectual and spiritual contributions.

This matter should be taken up for investigation by scholars of Chinese in India who have a full knowledge of the implications of Sino-Indian cultural contacts, and by scholars of Indology in China who can supplement their unique knowledge of the Chinese background by what they come to know about the Indian background. As one who has been interesting himself in the question of India's contact with other peoples, among other problems of Indology, the present writer thinks that actually India was not remiss in her interest and curiosity, and in her acceptance of certain things of intellectual and spiritual import from China; and he confesses to feeling very happy over this, as it takes away the stigma, at least to some extent, that India in her great centuries was not responsive to other cultures she came in touch with.

We know that the Indian mind and Indian artistic expression were both stimulated by the contact with Greek thought and science and Greek art, from the last quarter of the fourth century B.C. onwards. In science, India had enough of a cultural mind to accept Greek astronomy *in toto* as being more accurate and more scientific than her old Vedic astronomy which she abandoned by A.D. 420, and with this science she also took over a number of Greek words which form part of the astronomical technical terms in Sanskrit. There was no sense of exclusiveness, no inferiority complex in this borrowing of something of real value from foreigners, whose superiority in this matter was frankly admitted by Indian scholars; and their *amour propre* was not hurt by this.

It would appear that similarly in some other lines of thought or attitude towards the world, when India and China had direct contacts with each other from the first century A.D. onwards, at a time when India was for integration rather than segregation, India was attracted by certain things of the intellect and spirit which came to her from China, and she accepted them unquestioningly, and absorbed them in her own culture and made them entirely her own—as much as (or even more than what) China did with regard to the things in the ideological and technical world which came to her from India.

With the direct impact of Buddhism in China, Buddhist texts, mostly from Sanskrit, began to be translated into Chinese. The Chinese as an advanced people, with philosophical systems of their own, were actuated to translate abstruse Sanskrit terms of philosophy by their own Chinese words. Even in the matter of Sanskrit (Indian) names, the Chinese quite early followed the device of *translating* these names into Chinese, rather than trying to represent these unfamiliar Indian names as they were in the original Sanskrit. But still, hundreds of Sanskrit personal names and place-names were sought to be *transliterated* in Chinese, though it was a very unsatisfactory process because of the nature of the Chinese script, which was basically pictogrammatic and ideogrammatic. But a few common words have found a place in Chinese from the Sanskrit, with their pronunciation profoundly changing in the various modern forms of Chinese in the course of the last 2,000 years. Thus we have in the various forms of Modern Chinese the word *Buddha* pronounced as *Fu*, *Fo* and *Fat*; *San̥gha* occurs as *Sēng*, *Brahma* as *Fan*, *Śākya* as *Sha-chia*, *Kāśyapa* as *Chia-yeh* and *Ka-yep*, *Dharma* as *Ta-mo*, *Kumārajīva* as *Chiu-mo-lo-shih*, etc. etc. And there are scores of such disguised Sanskrit words and names in Chinese.

CHINESE WORDS IN SANSKRIT

Now, as we do not know of any Chinese book having been translated into Sanskrit (excepting the *Tao-Teh-King*, which was translated but has not yet been found in its Sanskrit version), we cannot expect Chinese words and names to come to Indian languages in ancient times. There was no scope for words of abstract sense to come to Sanskrit, either in the original Chinese or in Sanskrit translation. But names of some articles imported into India from China brought their Chinese names, and some of these have been found in Sanskrit and other Indian languages. We have so far been able to find *only about half a dozen Chinese words in Sanskrit*, which came to India some 1,800 to 1,000 years ago. Further investigation is sure to bring out some more of such Chinese loans to Sanskrit. We may mention the following :

(1) The name for *China* itself—Sanskrit *Cīna*, which is believed to be the Indianized form of the pre-Christian dynastic name of *Ts'in*—under the *Ts'in* dynasty, China for the first time became a great empire, and its fame spread to the West and the South—to Central Asia and Iran and India.

(2) *Silk* was a great contribution of China as a valuable textile product. Chinese silk came to India at least as early as the second century B.C. It was first known in Sanskrit as *cīnāṃśuka* or 'the cloth from the Chinese fibre'. Among various Modern Indian names for different kinds of silk, we have the word *tasara*—*tasar* in Assamese and Bengali, Anglicized as 'tusser silk', and this word, although it has been connected with a Sanskrit *trasara* (which itself may be a Sanskritization of the vernacular word), one is tempted to connect with the Chinese *tai-ssü* or *tai-sser*, meaning 'great or valuable silk'; and the late Dr. Prabodh Chandra Bagchi agreed with me in this affiliation of the Indian word *tasara*.

(3) *Bamboo flutes* used to be imported into India from China from the second century B.C. The Sanskrit word *kīcaka*, meaning a very slender kind of bamboo to make flutes from, has been connected by Sylvain Lévi with the ancient Chinese word **K'i-chok* (Modern Standard Chinese *Ch'i-chu*), meaning 'the bamboo of K'i'.

It must, however, be said in the above connexion, as my friend Professor Luciano Petech of Rome has drawn my attention to it, this proposed affiliation of the Sanskrit word *kīcaka* has been cogently controverted by the late Professor Jean Przyluski of Paris, himself a pupil of Lévi.

(4) *Sindūra*, the Sanskrit word for *vermilion*, apparently comes from an Old Chinese word, one of the modern pronunciations of which is *ts'in-t'ung* 'China lead'. Vermilion is known in Sanskrit also as *nāga-rakta*, i.e. 'blood of the snake or dragon'. Probably behind this name is some story which came from China with the vermilion dye itself, that this bright red colour was the blood of the dragon, which has such an important place in Chinese myth and folk-lore.

(5) The late Dr. Prabodh Chandra Bagchi found a word *śayaḥ* in a Chinese-Sanskrit vocabulary prepared in China in the eighth century. *Śayaḥ* is given as the Sanskrit equivalent of the Chinese word for 'paper'. This word is no longer in use, whether in Sanskrit or in any old or modern Indian language. (The common Indian word for 'paper' is a Central Asian word, which came through Persian in the form of *kāghadh*—*kāyaḥ*—or *kāghaz*, whence we have a Sanskrit *kāyagata*, besides *kāgada*, and Modern Indian forms like *kāgaj* or *kāghaz* in Hindi-Hindustani, *kāgaj* in Bengali, *kākot* in Assamese, *kāgad* in Old Hindi, in Gujarati and in Marathi). The word *śayaḥ*, according to Dr. Bagchi, is a borrowing in Sanskrit (and other Indian

languages also, presumably, in the seventh and eighth centuries A.D.) from the Chinese word for paper, which is now pronounced as *tsieh*, or *chieh*.

(6) There is a Sanskrit word of unexplained origin, *musāra*, meaning some kind of precious or semi-precious stone, and this is found in the *Mahābhārata*, the *Hari-vamśa* and other works, portions of which date from the early centuries after Christ, when Chinese contact with India was fully established (some of the oldest portions of the present *Mahābhārata*, of course, would go back to the beginning of the first millennium B.C., and other portions, in their subject-matter at least, may be even earlier). *Musāra* also occurs in the compound-word *musāra-galva*, which means 'a cup of some costly or rare stone'. I have suggested that this word *musāra* has come to India from China. In Chinese we have a compound-word of two characters which is now pronounced as *mo-so*, but the older pronunciations, before A.D. 1000, were **mwa-saḍ* or **mwa-sar*: and this word means also some kind of unidentified precious stone. The Persian and Arabic word for 'coral', *bussad* or *bissad*, is in all likelihood connected with the Chinese word; but who borrowed from whom in this case, we do not know.

The above list of 6 words may be looked upon as fairly attested or plausible borrowings by India from China. Unquestionably there are some more, which will have to be found out. Peaches and pears came to India from China, but no Chinese names came with these fruits—peaches were known as *cīnāni*, meaning just 'Chinese', or 'China fruits' (cf. the English word *China* meaning 'Chinese pottery'), and the pear was known as *cīna-rāja-putra* or 'the Chinese Prince', as a compliment to the deliciousness of the fruit. The current Indian names for these fruits are quite different, e.g. Panjabi *āḍū* or *ālū* for the peach, and *nāśpātī*, of Persian origin, for the pear (or a fruit allied to the pear).

From the third century A.D. some of the best scholars of China began to come to India. Before that some Indian religious preachers who took Buddhism, and Indian Buddhist literature and Buddhist art with it, had already been in China; and they appear to have created a profound impression on the Chinese people. The earliest missionaries from India of whom we have a record are the two scholars who went from India by way of Central Asia to China about A.D. 68, and established the first centre of Buddhism in China, which is still standing as a testimony to their great piety and enterprise, the *Pai-Ma Szū* or 'the White Horse Monastery' at Lo-Yang, at that time the Han Dynasty capital of China. The two missionaries were the monks Kāśyapa Mātāṅga and Gobharapa or Dharma-raksha. The present writer had occasion to visit this monastery (in November, 1958) and to offer his homage to the memory of these great sons of India, who were the first links in the golden chain of friendship between India and China, in front of their grave mounds (*samādhis*) and of their images, within the grounds and the halls of the Lo-Yang temple.

HOW CHINESE IDEAS FIRST CAME TO INDIA

The Chinese pilgrims and scholars who used to come to India, it may be naturally expected, evoked considerable interest in the mind of the Indians. Little bits of information about their sojourn in India and about what they did and said in India, can be collected together, to form an interesting chapter in the history of the early influencing of the Indian mind by that of China. These Chinese scholar-pilgrims came to procure Buddhist books, and to study them under proper masters, and to acquire a competence to translate them into their own language: and that was

their first objective. They also came to see the various holy places associated with the life of their Master, Buddha. But when they were living amongst Indians, whether in a Buddhist Monastery or University or in the Court of a King, one could be sure that all the while they were not talking about Buddhism and Buddhist philosophy; and Indians round about them were also asking for information about China and China's great culture, China's way of life, and various expressions of the civilization of China. When these Indians expressed a certain amount of want of knowledge or interest, they provoked a Chinese scholar like Hsuan-Chuang to a protest and to an admonition against this kind of un-informed mentality. We can be perfectly certain that in the course of their close exchange of ideas and friendly conversation, intelligent Indians, who were both monks and lay-men, scholars and men of affairs, came to know a lot about China, and found out how China both agreed with and differed from India in many respects, in her life and culture. They would not be discussing abstruse points of Buddhist philosophy only, but we may be pretty sure that they were also discussing history and travel and literature and art. Some notions about Chinese literature and its content and ideas and expressions in this way filtered down to the Indian scholars of the day, who had the privilege of coming in touch with the visiting Chinese pilgrim-scholars. And the result we see, though in an indirect manner, in Indian art and Indian literature. Enquiry in this matter in a deeper and more systematic way could be further pursued.

CHINESE ART AND INDIA: GUPTA COINS

During those great centuries, when we were producing the frescos and sculptures in the caves of Ajanṭā and the magnificent cave temples and rock sculptures of Mahābalipuram and Ellora and Elephanta (after the initial work in this line was achieved in pre-Christian centuries at Barābar Hill and Udayagiri and Khandagiri in Eastern India and at Bhājā and Karle in Western India), Buddhist China was not idle, and nor were distant Korea and Japan. As a fitting counterpart of the Ajanṭā frescos, we have the magnificent frescos of about the same period in the temple walls of Horiuzi (Horiuji) in Japan and the later frescos at Tun-Huang in China, and the equally great Buddhist sculptures at Yun-Kang and Lung-Men and other rock-temple sites in China. Competent scholars have suggested that although there was plenty of Indian influence in these expressions of Buddhist art in China, Korea, and Japan, there was also a large amount of independent Chinese, Korean and Japanese approach; and it has even been suggested that there might be some influences of Chinese painting on that of Ajanṭā. This was a great period of give-and-take between the two great cultures, and so it need not be at all surprising if that were true. Indian influences are noticeable in the sculpture of Iran in the Sasanian period, and there is also evidence of the influence of the Achaemenian, Parthian, and Sasanian Iranians on the art of India along the centuries. I have noted one or two things in the domain of art—how Indian metalwork in the centuries round about Christ was influenced by that of Iran in successive centuries. The coins of the Gupta Emperors are among the most artistic in the history of Numismatics. After the coins of ancient Greece and Rome, the most artistic coins of the ancient times are those of the Gupta dynasty in India. In these coins, there are, of course, some relics of Greco-Roman influence. The Kushāna Emperors of Iran, Central Asia and North-Western India had adopted the title of the Chinese Emperor *T'ien-Tzū* or 'Son of Heaven' as one of their own titles

(the Chinese expression was translated by them into Sanskrit as *Dēva-putra*, and in the Iranian Pahlavi as *Bagh-puhr* or *Bay-puhr*, from Old Persian *Baga-putra* or *Baga-puθra*, which was later modified into Arabic as *Fagh-fūr* or *Fay-fūr*).

Similarly, we find also some results of Chinese contact, at least in the domain of art, as patronized by the Gupta Emperors in India. The Gupta coins have inscriptions in Sanskrit in the Gupta-Brāhmī character of the fourth and fifth centuries A.D. These Sanskrit inscriptions are written along the rim of the coin in the ordinary Indian way, the letters running from left to right. Thus, for example, we have full Sanskrit inscriptions, like—*apratirathō rājā jītvā mahīm sucaritair divaṃ jayati* ('the king without a rival, after having conquered the world, is now conquering Heaven by his good deeds'), but the name of the king is given in the middle of the coin, beside his standing portrait, with the letters written in the Chinese fashion from top to bottom, and the two lines going from right to left (the *aksharas* or Indian syllabic letters being given in two lines, *Sa-mu-dra* and *Gu-pta*, written from top to bottom). In later Chinese-Sanskrit dictionaries prepared during the period of the T'ang emperors, Sanskrit words were written in the same way, the *aksharas* being put down one below another in the style of the writing of Chinese characters. This device, which was employed here by the designer of the coin, was certainly something new in the decorative use of the alphabet in India, and it looks like having been inspired by the example of Chinese writing, which, it may be presumed, the artist had seen, and it had probably struck him as something novel which could be introduced on the coin. If it is argued that it was an original idea of the artist, without reference to Chinese writing, it can only be said that this is one of many points where we find agreement with things Chinese, and this agreement came up after our contacts with China had taken shape and were in a flourishing condition. Then, in some of the Gupta coins, as for example in the *Aśva-mēdha* or Horse-Sacrifice Coins, the figure of the horse resembles the horse in contemporary Chinese art. The pennon or little banner is depicted in the coin on a staff in front of the horse, as flying in the wind, and this floating drapery suggests similar treatment of Chinese drapery. Students of Indian and Chinese art, I am sure, will be able to find out some points of agreement. Chinese pictorial art has got specimens preserved for us from early pre-Christian centuries, and in the fourth century A.D. there was the great Chinese painter Ku K'ai-chih, whose stately figures of Chinese men and women in the three or four great paintings ascribed to him, which are still preserved, give us some idea of the achievements of the Chinese pictorial art just before the Gupta period in India.

CHINESE LITERATURE AND THE LITERATURE OF INDIA: THE CHINESE AND INDIAN ATTITUDES TO NATURE

It has also been suggested that there is a good deal of agreement between the Chinese attitude to art and the Indian attitude, and here there might be mutual influencing. But this matter has not been considered carefully on a comparative basis. One thing is noteworthy. In Ajantā there is a great deal of the study of the still-life in Nature like flowers and fruits, and occasionally trees; and animal life in Nature is also treated in Indian art with a good deal of sincerity and sympathy as well as realism and gusto. But landscapes and nature-paintings are virtually absent in Indian art. As we shall see later on, in dealing with Chinese and Indian attitudes to Nature, it would appear that the Chinese early developed the

habit of detaching themselves from Nature, and this enabled them to contemplate Nature as one would contemplate a scene in a landscape. Hence we have quite early in Chinese painting the development of the landscape, which was lacking in Indian art.

In the domain of literature we note also certain new approaches in India (as in Sanskrit literature), which we do not find to be so prominent before our Chinese contacts. The first thing to note is the Indian and the Chinese attitudes to Nature. The Indian attitude to Nature, beginning from the Vedic period onwards, has been that man is not separated or detached from Nature; and this attitude has been described as being rather primitive (the word being used without any disparagement), in as much as man feels himself to be quite a part of Nature. He is always conscious that he is for ever *in it*, and he is not an entity outside Nature. He is not conscious of detaching or separating himself from his Mother Nature or Mother Earth, and of thinking himself either as a Master over Nature, who must and can control Nature, or who could appreciate Nature and her beauty from the outside, as it were. The Indian conception of a single Principle running through the whole universe, animate or inanimate, forms the basis of this idea. We have plentiful evidence of it in ancient Indian literature. Man is a part of Nature, and therefore he has a sort of kinship with Nature. In Kālidāsa's *Śakuntalā*, we find that Śakuntalā most easily and naturally looks upon a creeper, which she has named *Vana-jyōtsnā* or 'Moonlight of the Grove', to be as a sister to her. She has become a veritable mother to a motherless fawn which was her pet. The sentiments which are expressed by St. Francis of Assisi in his famous 'Canticle of the Sun' are echoed in the *Rig-Veda*; and in a late Sanskrit work like *Vairāgya-Śataka* of Bhartrihari. The powers and forces of Nature are brothers and sisters of man, as much as Heaven is his Father and Earth is his Mother. Classical Sanskrit poetry is redolent with the spirit of woods and forests and with the diverse atmosphere of the various seasons, and within this background Man is just a component of it, and is not something detached and placed outside. In China, this attitude, it must be admitted, cannot be said to be entirely absent. But quite early, both in China and in India, sages and thoughtful men developed the habit of withdrawing into themselves and living secluded lives 'far from the madding crowd', so that they might feel to be at one with Nature, as in the case of most Indian sages; or to contemplate Nature and find pleasure from this contemplation, as in the case of the sages of China. The Indian *Rishis* and *Sannyāsins* who had abandoned the world generally chose as their abode some little cottage in the heart of the forest or along the slope of a mountain, or in some natural cave (and in later times there were also artificial caves excavated for them by kings and rich devotees), with some mountain stream running in front, and there they would meditate and think and try to be in tune with the Infinite, and also take their fill of the beauty and bliss of Nature. A certain amount of detachment from Nature was inevitable, naturally enough, in such an attitude, although they wanted to feel at one with Nature in their quest for Nature's God. In Sanskrit literature we have as quite a common thing this kind of situation, namely of a forest hermitage and of an isolated ascetic living in some cave or hut to feel inner harmony and unity of spirit with the Infinite Unseen Reality as manifested through Nature. In the Buddhist (Pali) *Thēra-gāthā*, giving in some cases the personal and subjective thoughts and effusions of Buddhist monks in early times, we have a number of most exquisite poems in which the voice is heard of a solitary monk, living (like the Brahmanical *sannyāsins* or sages and *tapasvins* or ascetics dedicated to the realization of the

Supreme Spirit) in some mountain glade all by himself. He has as his habitation some cave, and there he sits enjoying the beauties of Nature spread before him in the different seasons. All this presents a very charming picture of this kind of attitude and life. In China this thing is also found from very early times, and it would appear that here China developed this detached life for Nature independently of India. We can think particularly of the Taoist teachers and thinkers in China, beginning with the great Lao-tzū himself, as being in this line. Later on, from both India and China the two streams united in Chinese literature. We have, as a result of the influence of the *Dhyāna* or *Ch'an* School of Buddhism in China, this sense of an exalted detachment from the world of man, with a view to taking into one's spirit the beauty of the world of Nature, becoming a very common subject in Chinese poetry, particularly when Taoist and Buddhist monks began to build their temples and monasteries in isolated spots among hills far away from the dwellings of men, where they lived in the midst of the beauty and sublimity of Nature. Chinese poetry and Chinese landscape paintings are full of this kind of thing—the Scholar's or the Taoist or Buddhist Monk's retreat among the hills being a favourite subject-matter of both Chinese literature and painting.

But quite early, in China, it would appear, they developed a sort of a conscious attitude of detachment from Nature, although they were in the midst of Nature's beauty; and this detachment was with a view to appreciating Nature much more fully. This attitude of deliberate or conscious detachment with regard to Nature is also the modern attitude. In India, it would seem that in Kālidāsa, particularly in his *Mēgha-dūta*, we have for the first time a sort of an intermingling of the two kinds of reaction to Nature. There is the older and deeper and more primitive feeling of being one with Nature, feeling oneself as a part of it; and at the same time there is also the feeling of the modern man, which can be characterized as more advanced, more sophisticated and more introspective, namely of holding oneself aloof from Nature in order to have a greater appreciation of Nature's beauty and sublimity. My own personal view is that in this matter this detachment in the modern spirit in Indian (Sanskrit) Nature poetry, which we see in Kālidāsa's wonderfully beautiful vignettes of Nature, is due to the Indian poets and writers (at least some of them) coming in contact with the Chinese attitude and manner. In the *Mēgha-dūta* of Kālidāsa, we find most beautiful descriptions of the various sights and scenes which the Cloud as the Yaksha's messenger to his beloved wife was to see on his way to the Yaksha's home in Alakā in the Himālayas. Here we have a series of most exquisite verbal landscapes from Nature and word-pictures of natural scenes, which were being surveyed by a scholar-poet who was moved to the depth of his being by the beauty of Nature, and who, instead of being lost in it as a part of it, was successful in steering himself clear and emerging from the meshes of Nature, and was able to be intoxicated by her beauty from a point of vantage outside, so to say. We find similar beautiful word-pictures in all the other works of Kālidāsa, including his *Śakuntalā* and his *Kumāra-sambhava*. What Kālidāsa achieved in the *Mēgha-dūta* and other works was unquestionably something new and great in Indian literature, and this is one of the reasons why Kālidāsa's name and fame have never been dimmed in India, and why the *Mēgha-dūta* still forms a perennial source of joy for lovers of literature and of Nature. But this point was not taken up for treatment in their poetry in the same manner by other writers of India subsequently; and this wonderful Nature-note of Kālidāsa in the hands of most of the later writers became something conventional and lifeless—even when we have such a wonderful

sweetness of language as in Jayadeva. Here and there, of course, we have in single-verse stanzas some beautiful descriptions of Nature in her beauty, in later Sanskrit poetry. But, on the whole, this note of a detached appreciation of Nature in all likelihood came to India, or was strengthened in India, through contact with Chinese scholars and men of faith like Fa-Hsien.

CHINESE LITERATURE AND KĀLIDĀSA: THE *MĒGHA-DŪTA*:

THE ART OF THE GARDEN IN CHINA AND IN INDIA

Kālidāsa lived about A.D. 400, in the first flush of Gupta grandeur, and that was the time when Fa-Hsien also came to India. I would not insist upon it, but it seems to me that in the story frame-work of the *Mēgha-dūta* there is also Chinese influence. The idea of sending a Cloud to take a message, from one who is far away and is compelled to stay there, to a dear friend or a beloved person, is of course very natural, and it can come to the mind of any poet sensitive to the things of Nature anywhere in the world. This is the basic theme of the *Mēgha-dūta*, namely, sending the Cloud as a Messenger. It may be that Kālidāsa was not at all indebted to any one, and much less to Chinese literature for this. But the fact remains that sending or asking the Cloud to act as a Messenger to one's beloved is a common enough *motif* in ancient Chinese poetry. One of the greatest poets of ancient China, who is now regarded as the greatest poet with an individuality and personality of his own who flourished in pre-Christian China, viz. Ch'u Yuan (who lived approximately from 340 to 278 B.C.), uses this *motif* or idea in two of his poems. In a little poem of his, entitled 'Longing for My Love', he says that he is sending Clouds as his Messenger (see *Li Sao and Other Poems of Chu Yuan*: translated by Yang Hsien-yi and Gladys Yang, Foreign Language Press, Peking, 1953, p. 55):

Lonely, longing for my Love,
I gaze afar in my Distress.
Far from Home and Go-between (i.e. an emissary),
How shall I my Grief express?

Clouds I seek as Messengers,
My petition they deny;
Swallows would swift Envoys make,
Heedless they have flown on high.

Ch'u Yuan has not pursued the idea beyond this in this short poem. But in one of his two biggest poems, namely the *Li Sao* or 'Falling into Trouble' (the other one is 'the Great Summons to the Soul'), Ch'u Yuan again has the *motif* of seeking the help of the Cloud as a Messenger to the lady of his love (*Li Sao and Other Poems of Chu Yuan*, as quoted above, pp. 10-11), and the following passage as being *à propos* may be quoted:

I wandered eastward to the Palace green,
And Pendants sought where Jasper Boughs were seen,
And vowed that they, before their Splendour fade,
As Gift should go to grace the loveliest Maid.
The Lord of Clouds I then bade mount the Sky.
To seek the Stream where once the Nymph did lie.
As Pledge I gave my Belt of splendid Sheen,
My Councillor appointed Go-between.
Fleeting and wilful like capricious Cloud,
Her Obstinacy swift no Change allowed,
At Dusk retired she to the Crag withdrawn,
Her Hair beside the Stream she washed at Dawn . . . *

* I am indebted to Dr. Mahadeva Prasad Saha for obtaining this reference to Ch'u Yuan's *Li Sao* from friends in China.

Another Chinese poet, who lived about A.D. 200, and was one of the seven great poets of China during the last years of the Han dynasty, Hsu Kan, wrote a beautiful little poem, which has been translated by H. A. Giles in his *History of Chinese Literature* (1901: pp. 119-20):

O floating clouds that swim in heaven above,
 Bear on your wings these words to him I love . . .
 Alas! you float along nor heed my pain,
 And leave me here to love and long in vain!
 I see other dear ones to their homes return,
 And for his coming shall not I too yearn? . . .

This agreement between the Chinese poet and the Indian one was noticed by the distinguished Indian scholar and linguist, the late Harināth De, as early as 1909, when he wrote an introduction (in English) to an appreciation of Kālidāsa written in Bengali by Pandit Rājendranāth Vidyābhūṣaṇa. He has quoted there the above passage from Hsu Kan as given by Herbert A. Giles. A pretty or a great idea easily passes from writer to writer, and from literature to literature. Hsu Kan was also a Buddhist scholar, who had translated at least one Buddhist text into Chinese—the *Prajñā-mūla-sāstra-ṭīkā* of Nāgārjuna. This is all the greater reason that a Buddhist pilgrim to India like Fa Hsien would be knowing about him as a Buddhist author (and his work, including his poem), and would be passing on some information about them to inquisitive friends in India. This idea of sending the Clouds as a Messenger was taken up from Kālidāsa by the German poet Schiller, when he made Mary Stuart think of sending a message to the beloved country she was leaving, France, when she was returning back to Scotland by ship. Ch'u-Yuan's famous *Nine Odes* have beautiful pictures of Nature in the mountains, which are the haunts of the Gods. There is a family likeness between these beautiful poetic descriptions in the *Nine Odes* and what we find in the *Mēgha-dūta* and other similar Sanskrit poetry; and also in Old Tamil literature. But here I would not think that there has been any direct influence from China.

The garden described in the *Mēgha-dūta* as forming a part of the Yaksha's house at Alakā in the Himālayas can be very well illustrated by a typical old-style Chinese garden with its artificial rockeries (*krīḍā-śaila*), its banana-grove, and its lotus-pond. Bamboo-groves in a garden are a common feature in India and China (*vēṇu-vana* or *vēṇu-kuñja* in India). Mogul gardens and the traditions of the art of the garden in Persia and Central Asia in the sixteenth and seventeenth centuries later made a mark in India. Did the very advanced Chinese art of the garden exert some influence on India of the early centuries after Christ? The very high level of the art of the garden in ancient times is attested by the unique T'ang and Sung Period gardens at Soochow and Hangchow and elsewhere, not to speak of the later Ching Period gardens in Peking, for instance. India herself of course had her own garden-art, and that does not preclude foreign ideas from coming in and enriching it.

But in another matter, it seems that a literary situation or *motif*, which is very common in China, has influenced the story frame-work of the *Mēgha-dūta*. In the *Mēgha-dūta* we have a young couple who were so much engrossed in each other's love that they (or rather the husband) neglected their duty. Their master got angry with them, and the lovers were punished by being forced to live apart from each other for a whole year. This is the *motif*, and it would appear to be very common enough, and could be quite a universal *motif*. But in the mythology of Old China, we have that famous story of the Weaving Girl and the Herds-boy, Tsih-Nü (Chih-Nü) and Khien-Niu (Ch'ien-Niu), where we have an analogous

theme. The Weaving Girl was the daughter of the Sun-God Shen-Yi in Chinese Mythology, and she was married to the young Herds-boy of Heaven, and they were so much engrossed in each other that she became remiss in her daily task of weaving garments for the Gods. So she and her husband were punished by being separated from each other for the entire year, and only once, after waiting for the whole year, they would be allowed to meet each other. This is also the pivotal story of the *Mēgha-dūta*; and there are in Chinese legends several other stories of a similar type. It is exceedingly likely, considering the various points of contact, that this *motif* was heard by Kālidāsa, and then he Indianized it entirely and used it in his *Mēgha-dūta*.

A comparative study of early Chinese literature on the one hand and Sanskrit and Prakrit literatures on the other is bound to show many points of agreement, and we have got to assess carefully the interchange of ideas in literature between these two great countries.

LATER TAOISM IN CHINA AND INDIAN TANTRIC *VĀMĀCĀRA*: A VENUE OF CHINESE INFLUENCE

In philosophy and in matters within the purview of religion, it is of course well known that China was very tremendously influenced by India through Buddhism. But even in this matter, certain influences in philosophy and in religious ideologies and practices appear to have come from China to India. I am not thinking of some basic agreements between China and India in the deeper reflections and speculations as well as intellectual conclusions, such as we find between Taoism and Upanishadic Vedānta. But just as certain schools of Buddhism like *Dhyāna* Buddhism of Bodhi-dharma became an important factor in Chinese Buddhist religious thought and practice, so it is believed that some later Taoist ideas and practices, which were partly religious, partly magical, partly scientific, and partly also in the plane of an erotic or sexual ritualism with mystic and philosophical implications, came to India from China. The sudden and widespread development of Tantric doctrines and practices, both among the Buddhists and the Brahmanists, from the second half of the first millennium after Christ, is rather significant in India. In these Tantric practices, sex and eroticism had a prominent place, as for example in the *Vāmācāra* rites of both the Brahmanical and Buddhist Tantrics, in which religious exercises or rituals with women formed the great characteristic. We do not find much direct reference or evidence from either side, but studying the matter second-hand and looking at the basic ideas behind some of these schools and practices, it would appear that we have to admit not merely the possibility but rather a strong probability of something having come from China to India.

CĪNĀCĀRA: 'THE WAY OR RITUAL OF CHINA' IN INDIA

This matter has been taken up by specialists (though not deeply enquired into, until quite recently) in India and Chinese studies during the last 60 years. There are several aspects of this question. In the first instance, there is the question of interactions between Buddhism and Brahmanism—not only in philosophy (which has generally been studied in detail), but also in their new worlds of Gods and Goddesses—their new (that is, post-Vedic and post-Puranic) pantheons, and in their rituals and practices. Mahāyāna Buddhism, as it developed on the soil of India, and in Nepal, Tibet and China, formed the natural *venue* for the introduction

of certain Chinese cults and rituals and religious and mystic ideologies (involving sexual commerce) which were the natural corollaries of old Chinese conceptions regarding the world and life as they were developed specially in later Taoism. Some newly-imagined and developed Mahāyāna Buddhist divinities and their worship formed the media through which specific Tibetan and Chinese ideas and practices could be transmitted to India, and passed on to be accepted and codified, so to say, in the Sanskrit Tantra literature of both Buddhism and Brahmanism. As early as 1900, Mahāmahopādhyāya Haraprasād Sāstri suggested the Mahāyāna Buddhist origin of some of the Gods and Goddesses who found a place in later Brahmanical religion and pantheon also, like some of the Bhairava or terrible forms of the God of Destruction which were identified with Śiva, and the Goddess Tārā who became identified with Umā or Durgā, the Great Mother Goddess, the female counterpart of Śiva. Haraprasād Sāstri also first pointed out from Sanskrit texts the connexion of the Goddess Tārā with Tibet and China and of the *Vāmācāra* practices with China. (See Preface to *Notices of Sanskrit MSS., Second Series*, by Mahāmahopādhyāya Haraprasād Sāstri, published under the orders of the Government of Bengal, Volume I, Calcutta, Baptist Mission Press, 1900). Sylvain Lévi in 1905 (in his work on Nepal, Volume I, Paris, Ernest Leroux, p. 346), while discussing the Gods and Goddesses actually worshipped by the Buddhists and the Brahmanists in Nepal, agrees, on the authority of the *Tārā-tantra* and other works described by Haraprasād Sāstri, that the worship of Tārā and the Tantric *Vāmācāra* practices, involving the use of the *Five M.s* (*Madya* or Wine, *Matsya* or Fish, *Māṃsa* or Flesh-meat, *Mudrā* or Gestures and Poses with the Fingers, or Snacks of Grain to be eaten with alcoholic drinks, and *Maithuna* or Sexual Intercourse), came from China. The knowledge in India of certain Mahāyāna divinities as being specially honoured in China, like Mañjuśrī and Samanta-bhadra, was already attested from iconographic literatures in India by both Sylvain Lévi and E. Foucher. In 1931, in the *Indian Historical Quarterly* of Calcutta for March, Prabodh Chandra Bagchi in an important paper on 'Foreign Elements in the Tantra' (pp. 1-16) took up this topic, and brought in fresh proofs indicating Chinese and Tibetan, and particularly Tibetan, influences in the evolution of some of the important or characteristic ideas, cults and practices of both Buddhist and Brahmanical Tantras. Binaytosh Bhattāchāryya, in his *Introduction to Buddhist Esoterism* (Oxford University Press, 1932), in the chapter on 'Influence of Buddhist Tantrism on Hinduism', has given a résumé of the Tārā and Vasiṣṭha legend, and discussed the question of the *Vāmācāra* being from the land of China (*Cīna-bhūmi*: pp. 155-56).

In the meanwhile, Sanskrit texts, which present the evidence of Chinese (and Tibetan) influences on Indian Tantric lore, literature and ritual, were being published by scholars who did not have any idea of the comparative or international aspects of the matter. As early as the seventies of the last century, from 1874 onwards, an enthusiastic believer from East Bengal in the Tantra and other allied subjects, Rasik Mohan Chatterji of the village of Butuni in Dacca District, brought out a whole series of Brahmanical Tantric texts from Bengal MSS. and printed and published them in the Bengali character. Among the works he had brought out were the following: the *Tārā-rahasya* by Brahmānanda Giri (which has been described by Haraprasād Sāstri from other MSS. in his *Notices of Sanskrit MSS.* mentioned above), the *Rudra-yāmala Tantra* and the *Mahā-cīnācāra-krama*, all of which make categorical statements about the cult and the *Vīrācāra* or *Vāmācāra* practices connected with the worship of the Goddess Tārā, that these came from China, being brought from there by sage Vasiṣṭha who was instructed by

Buddha himself, and who witnessed these practices in China itself. The *Mēru-Tantra*, which is a characteristic Hindu or Brahmanical Tantra, also mentions that the *Vāma-patha* or *Vāmācāra* ritual with sexual practices was also of Chinese origin (*Mēru-Tantra*, ed. Sri-Venkateswar Press, Bombay, Samvat 1965, Saka 1830 = 1908, Prakāśa I, Śloka 58ff.). In 1913, Akshaya Kumār Maitreya brought out an edition of the *Tārā-tantra*, an important work on the subject, from the Varendra Research Society, Rajshahi, Bengal, and the editor gave quotations from both the *Rudra-yāmala Tantra* and *Brahma-yāmala Tantra* giving the story of Vasiṣṭha obtaining the *Vāmācāra* practices from China.

The evidence from the Indian side is clear as to the belief regarding the Chinese affinities or origin of the *Vāmācāra* practices of the Indian Tantra, and about its being brought to India from China by a sage Vasiṣṭha. These practices and ritual are totally opposed to the Indian (Brahmanical) ways and ideas, and they have been clearly and categorically described in these Sanskrit works as being something non-Indian, and Chinese (*Cīnā-cāra*—‘the Way or Ritual of China’). This one important fact emerges from Indian Tantras, particularly those relating to the cult of Tārā in its *Vāmācāra* set-up.

‘THE INDIAN OR INDO-ARYAN WAY: ‘ĀRYA-CARITRA, ĀRYĀCĀRA’

The *Vāmācāra* ideology and ritual (in its *Cīnācāra* forms), although they have become accepted as an integral element of Hindu or Brahmanical Tantra as one of its recognized schools, present something which is quite new on the Indian scene, and is quite in opposition to the spirit and practices of Vedic and Puranic as well as Buddhist and Jaina aspects of Indianism: particularly when we consider the very strong note of asceticism and other-worldliness which characterized Indian thought and Indian life from the post-Vedic period. The Vedic Aryans, like their Indo-European kinsmen outside India, e.g. the Iranians, the ancient Hellenes, the Celts, and the Germanic and the Slavic peoples, had a robust and sane and quite a materialistic attitude to life. One of the great notes of Indo-European and Aryan mentality and behaviour was its spirit of moderation—it was for the avoidance of exaggeration in any department of thought and life. The Vedas indicate that the Indian Aryans took a frank delight in life as normal human beings; and enjoyment of the good things of life, including a happy married existence which was considered necessary for the average man to pay ‘the debt to the fathers (*pitṛ-ṛṇa*)’, by raising a family, was looked upon as perfectly natural, and correct. The four *Āśramas*—that of the celibate student, then the householder, then the retired man, and finally the man dedicating himself to the quest of God—formed the Brahman ideal in life. Everything at its proper time was the basic idea. It would appear also, judging from their present descendants, that the pre-Aryan peoples like the Dravidians, the Austriacs and the Mongoloids in India had a similar normal and healthy attitude to life and its joys. So in India, among both the pre-Aryans as well as the Aryans, sexual commerce was taken at its natural and obvious purpose—it was for procreation, for the perpetuating of the race as a divinely-ordained purpose in life. There was always an emphasis on the futility of cohabitation if it was not fruitful. A woman must have commerce with a man at the right time after her period—even if the legally married husband was not available—so that her period might not prove infructuous: that was an ancient way of looking at things, even among Aryan people in ancient India. There was the worship of the Great Mother who was also Earth, and the aim was to

conduce fertility in the woman by having a progeny as in the Earth by having plentiful crops. There was no ulterior spiritual or magical aim, to sublimate the unexpended semen into something of both material and esoteric value, for the man, as in later Tantricism.

But Jainism and Buddhism and some forms of Brahmanical asceticism created a rift by considering the householder's life as being on an inferior plane, conducing, as it was supposed to do, only to a lower order of existence with its scope for gratification of the flesh and pandering to the lower man. In practice, Jainism and Buddhism encouraged to the utmost the negation of life and the curbing of the healthy appetites or demands of the flesh. The continent life of the individual who had the holy fire of spiritual aspiration burning in him and reducing to ashes all his material passions always came to be considered to be on a higher plane, as an ideal to guide us in our mundane existence; and man was enjoined within the Indian orbit (after a Common Indian Philosophy of Life was gradually established during the first half of the first millennium B.C.) to spurn or control the world, the devil and the flesh. The Indian philosophy and practice of Yoga, which was something which had its roots in the pre-Aryan (Dravidian) people, sought by discipline of various sorts to make the body become subservient to the spirit. Plain and straightforward moral living, with strict chastity in the premarital state and faithfulness and continence in married life, was enjoined for all and sundry in ancient India. Caste and social discipline came in due course to make a regimented life in the material plane obligatory for an Indian, though in the intellectual and spiritual plane he was allowed the fullest liberty of adventure. This is the atmosphere which we find in the *Grihya Sūtras* which embody the social usages and the strictly moral life of householders within the Aryan or Brahmanical pale; roughly right down to the period a few centuries after Christ.

But with the advent of the Tantras and the *Vāmācāra* practices, from the second half of the first millennium after Christ, we see a new philosophy of life and a new religious and ritualistic atmosphere. Roughly, here we have a glorification of the body, or rather of the flesh, rather than a sane and reasonable continence in life. The widest licence and indulgence in the appetites of the flesh, according to this attitude, formed the easiest path to attaining the *summum bonum* in life, provided this licence and this indulgence were hedged in by some mystic rituals and ceremonials, which were partly magical, and partly scientific in that they were physiological. The *Yōga Sūtras* of Patanjali, in the old Brahmanical (and probably also in the pre-Aryan Indian) tradition, declared that personal cleanliness was useful, because it helped one to feel a disgust in one's own physical body and because it engendered a spirit of avoiding physical contact with others (*śaucāt svāṅga-jugupsā, parair asamsargaḥ*: Aphorism 40, Chapter II). But the Tantric *Vāmācāra* went totally against all canons of *śauca* (personal physical as well as ceremonial cleanliness), and declared that the fullest indulgence in the senses was the right way, provided certain regimentations were observed, to develop a transcendent and even an immortal body which could also be in possession of miraculous powers.

The Aryan (as well as the Dravidian and Austric) Gods had some of them their wives, and there was no deep meaning or philosophy attached to the conception of female divinities. The patriarchal social organization of the Aryans presented a contrast to the matriarchal one of the Dravidians. The Great Mother Goddess of a matriarchal society, who was brought into India by the Dravidians from Asia Minor and the Eastern Mediterranean Islands, was also conceived as an All-Powerful Force which was identical with Nature itself. In front of this puissant and eternally active

Śakti or Power that was the Great Mother of the Universe, her male counterpart was virtually an ineffective being. This idea also developed in India; and in the Tantras one of the basic concepts is that of the *Śakti*, or the Wife or Female Counterpart of a God. The God was a mere male, and all his power lay in his Female Form who was looked upon as his wife, repository or mainspring of his *Śakti* or Power.

Sexual and erotic practices in the Tantra came with the full establishment of the cult or the ideology of the *Śakti*. Binaytosh Bhaṭṭācāryya in his edition of the *Guhya-Samāja* (Oriental Institute, Baroda, 1931), which is one of the oldest Buddhist Tantras, going back probably to the seventh century A.D., as suggested by Dr. Joseph Needham (see below), rather than the third century A.D., as suggested by Bhaṭṭācāryya (and there is no Brahmanical Tantra which is as old as this), explains how this work is closely connected with the *Yōga Sūtras* of Patanjali, and at the same time it is in this work that we find the cult of the *Śaktis* introduced into the (Mahāyāna) Buddhist pantheon. The *Guhya-Samāja* brings in a lot of ceremonial, with worship of many of the Mahāyāna divinities, and inculcates also the sexual ritual with women. This became one of the basic Tantras for the Buddhists, but as yet there is no mention of China or the specific 'Chinese ritual' (*Cinācāra*) in it.

In this sexual religious ritual or practice as in the Tantra, one of the objectives was the retention of the seminal fluid in the sexual act, preventing its ejaculation. The devotee or adept is to become an *Ūrdhva-rētas*, one whose semen even in coitus goes through the stations along his spinal chord to his brain, and in this way it is sublimated into a factor for physical and psychical elevation of the Man. The word *Ūrdhva-retas* is found in later Vedic literature and in the *Mahābhārata*, but there it meant only 'chaste', and the other sense as in the Tantras is evidently a later extension of the original word, when a new idea and a new practice came into the Indian scene. It is to be noted that in Vātsyāyana's *Kāma-sūtra*, that exhaustive treatise on erotics going back to the early centuries A.D., there is no mention of this idea and practice.

Among the Aryans, there were magic and witchcraft and practices to bring about the removal of illness or to do harm to an enemy or a rival, and this was an expression of a primitive and a lower religion common enough among all peoples. The *Atharva Veda* is the repository of the Aryan literature of charms and magic, whether black or white. The Tantras also are the acknowledged treatises—a good number of them—on magical practices side by side with the erotic and sexual ones. In later texts, the magic and witchcraft of the Tantras (*māraṇa*, *uccāṭana*, *stambhana* and *vaśikaraṇa*) were affiliated to the magical rites (*abhicāra*) of the *Atharva Veda*, and thus the much desired Vedic connexion was found for the Tantras when they came to have a place in Brahmanism. But one thing we are to note. There has never been anything specifically connected with the sex in Aryan magic and magical rites as in the *Atharva Veda*. All this is late, and fundamentally *Vāmācāra* or *Cinācāra*.

THE CHINESE WAY: *CINĀCĀRA*

This idea and this practice originated in China with later Taoism, when the highly philosophical concepts, given out in such palpable sincerity of conviction and force of universal appeal as in the *Tao-Teh-King* of Lao-tzū—concepts in which we have the postulation of *Tao* or 'the Way' (which could be best rendered by the word *Rita* in Sanskrit) as the Supreme Reality in its unmanifest form (something like the Brahmanical concept of *Nirguṇa*

Brahman), as well as of Tao as manifesting itself in the different forces and powers, the divinities and supernatural creatures in the mundane world—were further developed. Herein the very ancient Chinese conception of the Male and Female Principles as working through everything in life and being, the *Yang* or the Male or Positive Power of Light and Heat and the *Yin* or the Female or Negative Power of Darkness and Cold, came into full play when the Taoists extended their scope of enquiry and work from the domain of the purely mental and philosophical to the material or mundane. The *Yang-Yin* complex was of course already there in the oldest form of Taoism of which we have record. The Harmonization of the ever-present *Yang* and *Yin* and the strengthening of the *Yang* in Man became a definite aim of later practical Taoism, and this aim was for the purpose of making Man transcend his physical limitations by acquiring supernatural powers and even immortality in his physical body. This led to the development of what may be called the physical sciences in China—Physics and Chemistry, Physiology and Sexology, and Medicine, and physical exercises of various kinds.

In 1951, Dr. K. H. van Gulik, formerly Cultural Attaché to the Embassy of the Netherlands in India, and a distinguished Indologist and Sinologist, brought out a remarkable book in a *de-luxe* edition of 50 copies only from Tokyo—‘*Erotic Colour-Prints of the Ming Period, with an Essay on Chinese Sex Life from the Han to the Ch’ing Dynasty, 206 B.C.—A.D. 1644*’; and a note on this book, giving a condensed (and annotated) account of its contents, has been published by Dr. H. Goetz in *The Annals of the Bhandarkar Oriental Research Institute of Poona* (Vol. XXXVI, Parts I-II, January–April 1955, pp. 133–40). The contents of the work have, in the words of Dr. Goetz, ‘a bearing on many other subjects, and sheds important light also on certain aspects of Buddhist Tantrism and Hindu Saktism’. To quote further from Gulik and Goetz: ‘This (sexual) practice, again, has been the starting point of a secret Tantric-Taoistic ritual intended not only to increase the length of life, but even to win immortality for the adepts. In this ritual only, also perverse, gruesome and cruel practices have been evolved.’ And further: ‘This ritual sheds a most important light on certain obscure doctrines and practices of Indian and Tibetan mysticism, especially of Yoga, the Buddhist-Tantric Siddhācāryas and the Kaula-Cakra of the Vāmācāra Śāktas’ (p. 135, in the above article). These Chinese ideas about erotics, and erotic practices, are widely known, and followed in China, much more than are *Kāma-sāstra* ideas in India.

We get here one support for the Indian *Vāmācāra* being in origin a *Cinācāra*, from this evidence on the Chinese side. Further light on this *Cinācāra* has been thrown by Dr. Joseph Needham in the Second Volume of his monumental work on *Science and Civilization in China* (Cambridge University Press, Vol. I, 1954; Vol. II, 1956, on ‘History of Scientific Thought’). In this work, which is a mine of precious and precise information arranged and set forth in a rigorously scientific manner, the author has dealt with (among other things) the basic philosophic, political and social as well as scientific ideas of Taoism (pp. 33–164). Needham gives this as ‘the Aims of the Individual in Taoism: the Achievement of Material Immortality as a *Hsien* (or Immortal)’. This could be attained through the discipline of certain techniques in living, like (1) respiratory techniques, (2) heliotherapeutic techniques, (3) gymnastic techniques, (4) sexual techniques, (5) alchemical and pharmaceutical techniques, and (6) dietary techniques. The first one is as old as the Chou period (c. 1000 B.C.), and has its analogues in Indian Yoga (*prāṇāyama* or breath-control). The

second and third also have their Indian analogues (*Sūrya-namaskāra* and *haṭha-yoga*). The fourth is certainly special for China; and the technique (described by Needham in pages 146–52), or at least some of its ideas and practices, came to India as *Cinācāra*.

Chinese ideas and practices in these matters go back to pre-Christian centuries, and there is a fairly long succession of books in this connexion, as noted by Needham. The ideas and the practices behind the cult of the *Fifth M* (*Maithuna* or sexual union) *à la Chinoise* have been described by Needham, who also makes references to practices like the *Kula-cakras* of the Indian Tantras (pp. 149–51). His Chapter on Buddhist Thought and its Impact on China—the nature and doctrines of the main schools, their spread in China and the influence of Buddhism on Chinese Science and Scientific Thought and other matters (pp. 425–30)—are specially valuable for our purpose; and what has been said there has been said—and for the first time, too—in clear and conclusive manner, and I cannot resist the temptation of quoting some portions *in extenso* from Needham's book. 'The Taoist Department of Buddhism was Tantrism', as Dr. Needham has put it categorically and in the style of an aphorism. Buddhist Tantrism has been described by Dr. Sasibhushan Das Gupta in his *Introduction to Tantric Buddhism*, Calcutta University Press, 1950, which has been noted by Dr. Needham.

To quote from Needham's book (from pp. 425ff.) : *

The Tantras (*ta chiao*, or *shen pien*) were late sacred texts on the borderline between Hinduism and Buddhism, produced in India not earlier than the sixth century. The practices accompanying them were sometimes open (*dakṣiṇa-caryā*) and sometimes esoteric (*vāma-caryā*); and at first sight odd indeed. Worship (*bhakti*) of personal gods was prominent, but more characteristic was the strongly magical element, including 'words of power' (*mantras* or *dhāraṇīs*), talismans (*yantras*), amulets (*kavacas*), hand-gestures (*mudrās*) and other charms. These *i kwei* overlap Tantric texts; the *Saddharma-puṇḍarīka Sūtra*, for example, has a whole chapter of *dhāraṇīs*. Tantrism adopted as its symbolic forms what one might call 'electrical' imagery; it was known as the 'way of the thunderbolt' (*vajra-yāna*: *ch'in kang chheng*). One can see at once that one is in the presence of a system of thought closely akin to the shamanist and magical side of ancient Taoism, and hence, on the principle that magic and science were originally united in a single undifferentiated complex of manual operations, here, if anywhere, Buddhism may have produced some contribution to science. [In this connexion, Dr. Needham refers to Prof. Sasibhushan Das Gupta's *Introduction to Tantric Buddhism*, Calcutta University Press, 1950].

It is then of great interest to find that just as ancient and early medieval Taoism was deeply interested in the phenomena of sex, so also this was central to Tantrism. The *vajra* (thunderbolt or lightning flash) was identified with the male external generative organ, the *liṅgam* (*seng chih*), while the lotus, *padma* (*lien*)—so characteristic of Buddhist iconography—was identified with that of the female, the *yoni* (*nü ken*). Essentially the theological doctrine was that the mystical or divine energy of a god (or of a Buddha) resided in his female counterpart, from whom he received it in an eternal embrace. There had to be one of these *śakti*, therefore, for each god or Buddha. The logical conclusion followed that the earthly *yogi* seeking for perfection must also embrace his *yoginī*, in a sexual union (*maithuna*) prepared for and conducted with special rites and ceremonies (*cakra*). There followed also the worship of women (*strī-pūjā*) as a preliminary to *maithuna*. The whole forms a remarkable parallel to the practices of early medieval Taoism (cf. pp. 149–51), though Buddhism seems to have come a long way from its origin when we find the phrase *Buddhatvam yoṣid-yoni-samāśritam*—Buddhēity is in the female generative organs . . .

One of the most important Buddhist Tantric texts is the *Guhya-sāmāja-tantra* or *Tathāgata-guhyaka* (ed. B. Bhattacharyya), which is certainly not earlier than

* In quoting from Dr. Needham's work, I have omitted all reference indications by means of numbers and letters, and have taken the liberty of changing the symbols used by him, + (plus) and – (minus), respectively, to A.D. and B.C.

the seventh century. We are not surprised to meet with a good deal about the control of respiration (*prāṇdyama*) in it. The *śakti* element is also very strong, and indeed here the union of the sexes is said to be of the essence of Tantrism. The theory was that emptiness (*śūnyatā*) was of male quality, while compassion (*karuṇā*) was female; in order, therefore, to achieve unity (*advaya*) a sexual act was required. This looks almost like a symbolization of the two basic trends in Buddhism, the nihilistic philosophy on the one hand, and the warm-hearted love for all beings on the other. In that sense one may feel that the best in Buddhism was derived from its *Yin*, or *śakti* side. It is interesting that Tantrism, like Taoism, encouraged woman adepts, and we find names such as those of Lakṣmīṅkarā (fl. 729) and Sahajayoginī (fl. 765) in the lists of its leaders.

Indian Buddhist Tantrism appears to have come to China in the eighth century. As Chou Yi-Liang points out, in an interesting paper, it was not that magic formulae (*dhāraṇīs*) had failed to arrive much earlier. Sūtras including these had been translated as early as 230 (A.D.) by Chu Lü-Yen, and in 313 (A.D.) by Chu Fa-hu (*Dharma-rakṣa*), both Indian monks, as well as by many others; the spells included methods of rain-making, getting water from rocks, finding springs and sources, stopping storms, etc. Just as in Taoism, one real discovery or sound observation probably accompanied a hundred imaginary wish-fulfilments. The field has been so uncultivated that much research will be required to assess the place of these practices in the history of science. In the Tang the traffic greatly increased, largely owing to the labours of three Indian monks, Śubhakarasiṃha (Shan Wu-wei, 636 to 735), who came to China in 716; Vajrabodhi (Chin-Kang-Chih), d. 732; and Amoghavajra (A-Mou-Ka) or Pu-Khung (d. 774). But the Chinese were also active; monks such as Chih-Thung wrote much on Tantrism, and the great traveller I-Ching translated a Tantric Sūtra, the *Ta Khung Chhiieh Chou Wang Ching*. But the most important Tantrist was the monk I-Hsing (672 to 717), the greatest Chinese astronomer and mathematician of his time, and this fact alone should give us pause, since it offers a clue to the possible significance of this form of Buddhism for all kinds of observational and experimental sciences. It would be surprising if there were no alchemical connexions, but the subject is difficult to investigate, because, for obvious reasons, Tantrists did not advertise their ways.

At first sight, then, Tantrism seems to have been an Indian importation to China. But closer inspection of the dates leads to a consideration, at least, of the possibility that the whole thing was really Taoist. In Section 10(i) (pp. 150ff. above), we saw that Taoist sexual theories and practices were flourishing between the second and the sixth centuries (A.D.) in China, definitely before the rise of the cult in India, and its reimportation (if it was a reimportation) by the Buddhists. Bhattacharyya significantly tells us here that the principal localities associated with Buddhist Tantrism were in Assam. This reminds us that one of Pelliot's most remarkable memoirs concerned a Sanskrit translation of the *Tao Te Ching*. It was made for Bhāskara Kumāra, King of Kāmarūpa (Assam), who had asked Wang Hsuan-Tshe for it in 644. A very living account of the work being done, with all the difficulties which the translation involved, exists in the *Chi Ku Chin Fo Tao Lun Heng* (Critical Collection of Discourses on Buddhist Doctrine in Various Ages) under date 647. Pelliot translated this. In Tantric literature, moreover, China (*Mahācīna*) occupies a very important place as being the seat of a cult *Cīna-caryā* which worshipped a goddess called Mahācīna-tārā (Bagchi: *India and China—a Thousand Years of Sino-Indian Cultural Relations*, 2nd edition, Bombay, 1950). Sages such as Vasiṣṭha were said to have travelled there to gain initiation into this cult, in which women played a very prominent part. Possibly, therefore, Tantrism was another instance of foreigners amiably instructing Chinese in matters with which the Chinese were already quite familiar. However, the sexual element in Indian religion had from ancient times been so marked that Buddhist Tantrism may actually well be considered a kind of hybrid of Buddhism and Hinduism. The *śakti* idea is certainly ancient (cf. S. K. Das: *Śakti or Divine Power*, Calcutta University, 1934).

In any case, it is possible to find detailed parallels of much precision between Taoism and Tantrism. It will be remembered that in Section 10 (p. 149), mention was made of the Taoist practice of *huan ching*, 'making the *ching*, or seminal essence, return'. In this method pressure was exerted on the urethra at the moment of ejaculation in such a way as to force the seminal discharge into the bladder, whence it was afterwards voided with the urine; the Taoists imagined, however, that it made its way up into the brain, which it nourished in some marvellous way. Now in Bose's book on the post-Caitanya Vaiṣṇavite (Hindu) Sahajiya cult of Bengal (Manindra Mohan Bose: *The Post-Chaitanya Sahajiya Cult of Bengal*, Calcutta University Press, 1930), still existing, we find that an

exactly similar method is used. In this sect, where the rites of *maithuna* are a kind of elaborately stylized and ritualized physical love, whether of couples married (*svakiya*) or otherwise (*parakiya*), the semen is made to go upwards to the region of *Paramātmā*. Though the physiological technique is not clearly described, the correspondence is too close to be accidental. There is, moreover, an epithet, *ūrdhva-retas* (lit. meaning 'upward semen'), which occurs commonly in the *Māhābhārata* and the *Rāmāyaṇa* epics, and which has often been translated 'chaste' or 'continent', but which may well have reference to this technique...

Summing up, then, one may say that Tantrism presents an aspect of Buddhism which has so far been quite insufficiently investigated. Scholars were formerly deterred by an attitude to sex so drastically different from that of occidental culture; they will now be repelled by the vast mass of apparently unprofitable and nonsensical charms and magic. But it must be remembered that out of the morass of magic grew up the flowers of true knowledge of Nature—as in magnetism, pharmacy, chemistry and medicine itself. I would therefore venture to say that Tantrism represents one of the fields of research in which interesting discoveries concerning the early history of science in Asia are most likely to be made.

Vis-à-vis Chinese thought (Confucian-Taoist), this is Dr. Needham's final view :

One must rest in the conviction that at any rate during the first millennium Buddhism was a great civilizing force in Asia. For Central Asia this term is surely appropriate, but for China, which already had a civilization of a high order, matters were a little different; Buddhism there introduced that element of universal compassion which neither Taoism nor Confucianism, rooted as they were in family-ridden Chinese society, could produce (p. 431).

The following opinions by two other experts on Chinese History and Chinese Thought will be *à propos*. R. B. Blackney, in the Introduction to his Translation of Lao-tzū (Mentor Books, New York, 1955), quotes from L. C. Goodrich's *Short History of the Chinese People* (New York, 1943) as follows : 'Taoism organized into a corporate whole the original primitive beliefs and customs, those that centred about the worship of nature, which was considered animate... The Tao, or Way, was the road one travelled in order to obtain three ultimate aims : happiness, wealth and long life. The intellectuals could do this by meditating on the writings of the masters and following their intellectual teachings and by consciously seeking longevity through studying alchemy and observing certain physical requirements, such as selective diet, breathing exercises, calisthenics and sexual practices...' Blackney observes (p. 48) : 'From the third century A.D. on, the subsequent story of Taoism is mainly concerned with the rivalry of Buddhism. The two religions were much alike except that Buddhism barred sexual practices, and its priests, for the most part, were celibate.' Elsewhere Blackney has emphasized upon the presence of *Yinism* or Exaltation of the Female Principle in Taoism, which is the old Chinese equivalent of Indian *Śaktism*.

REASON FOR THE VOGUE OF *VĀMĀCĀRA* (OR *CĪNĀCĀRA*) IN INDIA

Thus, the impact of the Chinese Way of Thought and Way of Life in this particular domain brought to India its Tantric *Vāmācāra* theories and practices. We need not now appraise the ultimate benefit or otherwise which accrued to the Indian people. There was enough of a high philosophy in India, and India's attitude was the cultivation of *Nivṛtti*, or Cessation from Worldly Ways. Tantrism gave a new kind of *imprimatur* to *Pravṛtti* or Indulgence to the call of the Flesh. It was different from the basic Naturism of the pre-Aryan peoples, and from the sane attitude to women and sex which was the Aryan attitude and which was also universal. But suffice it to say—and the reasons are to be sought out—that

a good section of the Indian people affiliated to both Buddhist and Brahman thought took eagerly to these *Vāmācāra* or *Cinācāra* ideas, and quite a good few to the erotic practices, although the higher religious sense of India always looked askance at it, and condemned it.

One reason for its finding a place in Buddhism was undoubtedly that it was a reaction to the negation of the world of the senses, which the teachings of Buddha so very categorically insisted upon, and which, although not so intransigently negative, also formed a pivot of the Brahman quest for the Ultimate Reality. Buddhism brought to China certain new things, no doubt, and was welcomed by the deeper spirit of quest in the Chinese mind which sought to transcend life and nature. But the acceptance of Nature as such and the logical termination of the line of argument in which Nature, conceived as the result of the eternal play of *Yang* and *Yin* which were living forces, led Taoism to the idea of *Hsien*-ship and the possibility of its attainment, and this proved to be an attractive ideology and discipline for those who in their mental composition or temperament were, to speak in the Indian way, towards the full and free play of the *Pravṛtti* or natural inclination and did not feel happy with the spirit of *Nivṛtti* which led to abstinence and asceticism. It was in this way that when they came close to the atmosphere of later Taoism, from the early centuries of the Christian era, that some Buddhists from India also found in it an alluring doctrine, which was sublimated and philosophized in the Indian way. In place of the Chinese *Hsien* or immortal, in India we have the *Siddha* or *Avadhūta*, the adept with miraculous powers (*siddhis*) which he can attain through Tantric practices, preferably of the *Vāmācāra* school. This would appear to have come to India with Tantric Buddhism sometime after the middle of the first millennium A.D., and then it joined forces with Indian naturism and eroticism, mysticism and magic, and was established as *Vāmācāra* or the Leftist Way, as opposed to the *Dakṣiṇācāra* or the Rightist Way. In Brahmanical Tantra, it associated itself with Śiva and Umā, and acquired a kind of scriptural or mythological *imprimatur* in later Hindu thought in general; and this was but natural, considering 'the hospitableness of the Indian mind', particularly in the domain of religious speculation.

FOREIGN RELIGIOUS INFLUENCES IN INDIA FROM THE WEST: GREEK AND IRANIAN GODS IN INDIA: THE IRANIAN *MITHRA* OR *MIHR*

If the *Vāmācāra* ideas and practices, as Brahmanical tradition in some of the important Tantric works as noted above makes it not only plausible but almost positive, came from China, it was not an isolated phenomenon in the history of religion in India. Thus, the Sun-God of Indo-European origin (**Suvelios* = Skt. *Sūryaḥ*, Greek *Hēlios*) came to India with the Aryans, and the Indo-Aryan (Vedic) Sun-God was quite a popular deity. Following descriptions in the Vedic literature, we have an early iconographic representation as in the famous bas-relief of the Sun-God (and of Indra) in the pre-Christian Bhaja Caves near Karle in Western India, and elsewhere. At Bhaja (as in other Indian sites), the Indian or Vedic Sun-God is depicted as riding a four-horsed chariot, with Ushas and Śaranyu, his two wives, by his side, and the two *Āśvins* on horse-back riding beside his chariot; and masses of darkness in the form of fierce-looking demons or giants are below his chariot-wheels. The Sun-God in his four-horsed chariot was an established image in Indian iconography, Brahmanical, Buddhist and Jaina, in pre-Christian times.

In the early centuries of the Christian era, probably during the time

of the early Kushana Emperors, India became closely connected with Iran, and Iranian and Greek and other western ideas easily came to India and were in some cases accepted by the Indians. By about A.D. 420, Vedic or old Brahmanical astronomy was discarded by the Indians who adopted the more accurate Greco-Chaldaean astronomy, with the seven planets and the signs of the Zodiac. The number and variety of the divinities depicted on Saka coins—Indian, Iranian and Greek—is a noteworthy thing, which testifies to the eclecticism in religious matters, in North-Western India at least. One great Iranian Goddess, *Anāhita*, whose name occurs in the Saka coins as *Nana*, appears to have become quite popular in India, and coins with the figure of *Nana* may have helped in this popularity. She became identified with *Umā*, or *Durgā*, the Great Mother Goddess of India, which was quite natural, and she is worshipped as *Nānī*, the Great Mother, by all Hindus, and specially by Śāktas and Tantrics, in her famous shrine within a cave in South Baluchistan, at a place called *Hinglāj*, which was a very holy Śākta place of pilgrimage to which hundreds, if not thousands, of Hindu pilgrims from all over India would undertake an arduous journey with camels from Karachi (possibly this place of pilgrimage is closed after the formation of Pakistan: the shrine, although frequented by Hindus, was in the keeping of a Fakir or religious man who formally belonged to Islam). The coins with the figure of *Nana* became popular in India, and we have evidence of its wide circulation in the Prakrit word *Nāṇaka* and the Panjabi word *Nānak* (from **Nanṇakka*) meaning 'a coin, a copper coin'. In the *Aṅga-vijjā*, a Jaina encyclopaedic work of remarkable cultural importance which probably goes back to the fourth century A.D., and which has been recently published in a very good edition by the *Prakrit Text Society* of Varanasi (Banaras) in 1957, gives the names of a number of Greek Goddesses (and Gods mistaken as Goddesses?). (Cf. English Introduction to this work by Dr. Moti Chandra, p. 42). These names are given in a much mutilated form, but it would be quite reasonable to argue that names of Iranian and Greek deities were still known, at least traditionally, in parts of India in the fourth century A.D., and possibly even later. The names are *Apalā* = *Pallas Athenē*, as suggested by Dr. Moti Chandra, but it may be a feminine transformation of *Apollo*; *Anādītā* = the Iranian *Anāhita*; *Airānī* (and *Airikā* also?) = Greek *Eirenē*; *Timissa-kesī* is identified with *Themis*; *Sālimalinī* is connected by Dr. Moti Chandra with *Selenē*, the Moon Goddess, and *Tidhinī*, which occurs in the list just before *Sālimalinī*, may be (as I suggest) *Tithonos*; and besides these above, there is the name *Abbharaṇyā* which might be for *Aphroditē*, the Greek name being first Prakritized into something like **Abbharaṇiā* < **Abhraditikā* = *Aphroditē* + Indian *-kā* affix.

The Iranian form of the Sun-God, *Miθra* in Old Persian and *Mihr* in Middle Persian, became transformed from a chariot-rider in India into a horseman in Iran, wearing the distinctive Iranian dress with top-boots. In this form he came to India, accompanied by Iranian priests—the *Magoi*, and he was identified with the Brahmanical Sun-God in his chariot, which later was drawn by seven instead of four horses. The Iranian Sun-God, booted and wearing a tunic, influenced Indian iconography, to the extent that, in Northern India at least, the Sun-God with his attendants became the only Indian divinity who wore boots, all other Gods and Goddesses being depicted bare-foot. Multan became an important centre of Sun-worship, and Al-Biruni (c. A.D. 1000) definitely mentions that the Multan image of the Sun-God was dressed like a Northerner. Now there is a well-known story of the Sun-God being brought from *Śakadvīpa*, the land of the Śakas, which can only be identified as *Saka-stāna* (or *Śaka-sthāna*),

present-day Seistan, in Eastern Iran, which was an important Saka centre, by Śāmba, the son of Krishna and Jāmbavati, who was afflicted with leprosy as a curse from some sages, and who could only be cured by performing austerities to propitiate the Sun-God. (This story has inspired the erection of that magnificent temple to the Sun at Konarak in Orissa in the thirteenth century). Śāmba brought with him a number of 'Śākadvīpiya Brahmins', who were known as *Magas*. *Maga* is the Iranian name for priests of the Iranian religion, pre-Zoroastrian and Zoroastrian. These *Magas* not only brought Sun-worship with them, which was strengthened in India, but they also introduced or reinforced Greek astronomy which became, possibly from after their advent, fully accepted by the Indian Brahmins. The Middle Iranian name of the Sun-God, *Mihr*, was introduced into India, and was adopted in Sanskrit as *Mihira* as another name of the Sun. Mihira's son, *Raevant*, who was the God of Hunting in Iran, also followed his father to India on horseback, and he was adopted as *Rēvanta*, the God of Hunting.

Here we have evidence of a Godhead from beyond the North-West Frontier of India being brought to India, some time before A.D. 400, and possibly near about A.D. 200, if not earlier still. The name of the person whose 'Mission' to Iran to find the Sun-God in a new form for worship in India is given, namely Śāmba, although it is a name which is more legendary than historical. Similarly, the sage Nārada is said to have gone to 'Śvēta-dvīpa' in the West, wherever it was, to bring the cult of Bhakti to India. There is no wonder that a similar thing did happen, at a slightly later date, and in the North-Eastern Frontier of India, in the case of another deity; and it was a Goddess, *Tārā*, ultimately of Indian origin it may be, who was transformed in her character in Tibet and China, and became connected with the *Vāmācāra* ritual; and the person, who brought this cult of *Tārā* and the ritual of the *Vāmācāra Cakra* is named as the sage Vasiṣṭha (Vaśiṣṭha), whose name also belongs to legendary history.

THE BUDDHIST (MAHĀYĀNA) GODDESS TĀRĀ, IN INDIA, TIBET AND CHINA

The origin of the Buddhist divinities, like the Brahmanical ones, is partly in folk religion and partly in philosophical speculation. Rudra in his benign aspect as Śiva in the *Yajurveda* is already known as *Tāra* or 'the Saviour'. A Goddess *Tārā*, meaning the same thing, could easily emanate from this. Then there is the Sanskrit word *Tārā* or *Tārakā*, which means a Star (from another root, which is cognate with the root in Persian *Sitāra*, Greek *Aster*, Latin *Stella* and English *Star*), and this word might easily give the name of a celestial Goddess who dwells among the stars. When the Bodhisattva ideal was developed in Indian Buddhism—and this development had its germs in primitive Buddhism, and was well on its way in the time of Asoka, third century B.C.—we have the creation of the great Bodhisattvas, among whom *Avalōkitēśvara* (or *Avalōkita-svara*) stands out pre-eminent. *Avalokiteśvara* is the Merciful One, who denied to himself the bliss of Nirvāṇa, so that he might stay on and be helpful to all erring and sinning and suffering creatures who could not have access to Nirvāṇa. He could thus easily be raised to a very personal God, a loving God of Mercy. His *Śakti* or female counterpart or repository of his energy is *Tārā*, the Saviouress, equally the Mother of Mercy. *Tārā* also became a very popular deity in India, during the early centuries after Christ when the Mahāyāna pantheon was developing, and was developing rather rapidly. She passed out of India to Tibet, to China and to the countries of Greater India. In Tibet she was very popular, and she was

there already in the seventh century A.D. She was *Sgrol-ma* (now pronounced *Dol-ma*) in the Tibetan translation of her name. She was, like her husband Avalokiteśvara (*Spyan-ras-gzig* = *Chen-re-si*), conceived under quite a large variety of subsidiary forms. Two of these were the *White Tārā*, and the *Green Tārā*. The *Tārā* cult, with the Goddess in her various forms, also went to China.

It would appear that *White Tārā*, or *Tārā dressed in White* (*Pāṇḍarā*, or *Pāṇḍara-vāsini* in Sanskrit) was also taken to China, as the *Śakti* of Avalokiteśvara. But in China, already Avalokiteśvara (*Kuan-Yin*) was on the way to transformation from a God into a Goddess, through the influence of the pre-Buddhistic (Taoist and Confucian) Mother Goddess *Si-Wang-Mu*, the Queen Mother of the West, the representative of *Yin* or the Female Principle, whose male counterpart, the representative of *Yang*, was the God *Tung Wang Kung*, the King of the East. Evidently in the course of her introduction to China in the seventh and eighth centuries, she became absolutely merged into her husband, who became transformed into the Goddess *Kuan-Yin* in China. The God and his *Śakti* are identified, and so it would not be a wonder if white-robed *Tārā* and Avalokiteśvara, as *Kuan-Yin Po-yi-ta-she*, or 'Bodhisattva dressed in white garments' in his transformation into a Goddess, would be looked upon as one and the same. It was towards the middle of eighth century, 'Kuan-Yin or Avalokiteśvara dressed in White' was introduced into China (cf. *Mythologie Asiatique Illustrée*, Paris, 1928, p. 330, in the section on the Mythology of Modern China by H. Maspero); and the White-robed *Kuan-Yin* became quite a popular deity in China. There is no doubt that this *Kuan-Yin-Tārā*, if such a hyphenated name could be used, is the most popular of the Buddhist divinities in China. In India, 1,500 to 1,000 years ago, Tibet was definitely known as *Bhōṭa*, and China was called *Cīna*, or *Mahācīna*; but in a vague way, as contiguous lands of the *Kirāta* or Mongoloid peoples, the ethnic and geographical names *Kirāta*, *Bhōṭa* and *Cīna* would be placed side by side and equated, and this sometimes led to confusion.

The influence of Buddhist Tibet in the development of Indian Tantric notions and cults, even to the extent of introducing some minor divinities who were within the domain of magic and witchcraft, and the introduction into Sanskrit texts of some names and words of Tibetan and other Tibeto-Burman origin, has been discussed and demonstrated by Prabodh Chandra Bagchi (in his article to the *Indian Historical Quarterly* mentioned above).

But Tibet was more or less a cultural adjunct of India, particularly in her Buddhism, whereas China was on a higher cultural level; and later Chinese Taoistic ideas, cults and practices had evidently come through Buddhist Tantrism into India, at least one century before Buddhism was introduced among the Tibetans in the seventh century. There were trade-relations between India and China through South-Eastern China and Assam even from the second century B.C., as the reports of the Chinese explorer Chang K'ien show. A Chinese song-dance, called 'the Prince of Ch'in breaks the Ranks', had come to India in the seventh century, and had intrigued Emperor Harsha-Vardhana who asked to know more about it from Hsuan Chuang, when he met the Chinese pilgrim. Hsuan Chuang explained the story to Harsha-Vardhana, and said something about the T'ang emperor who was contemporary to Harsha-Vardhana, viz. T'ai Tsung. There was thus some interest in India for China, and certainly China was equally or much more interested in India. The message of Taoism had already reached India, and, as we have seen, it was Taoism of the later mystic type which was paving the way for *Kulācāra* or *Cinācāra* in India. In 520, Song Yun, the Chinese traveller, during a short visit he

paid to Northern India, lectured on the *Tao-Teh King* of Lao-tzū before the King of Udyāna in North-Western Frontier of India. When the Chinese envoy Li Yi-piao was in India about A.D. 646, he went to Kāmarūpa, where he talked with the King of Assam, Kumāra Bhāskara, about Lao-tzū's *Tao-Teh King*, and the Indian king was eager to have a translation into Sanskrit of this work, as well as an image of Lao-tzū. This interest in Lao-tzū and his work is significant, if we consider that already Taoistic (later Taoistic though) ideas and practices were attracting Indian Buddhist thinkers and religious men.

The story of the sage Vasiṣṭha's visit to China (*Cīna*, or *Mahācīna*) in quest of instruction from the Buddha who was residing in China fits in very easily in the above context. This story is given in the *Rudra-yāmala Tantra*, which is one of the older Brahmanical Tantras going back to times before the sixteenth century, and may belong to the period between A.D. 1000 and 1300, and in the *Mahācīnācāra-krama*, which is of unknown date but which gives a fuller account and may be contemporaneous with the *Rudra-yāmala*. The legend became quite well known, and has been given or referred to in other works like the *Brahma-yāmala Tantra*. The story in brief is as follows (as given in B. Bhattacharyya's *Buddhist Esoterism*, 1932, pp. 155-56) :

In the *Rudra-yāmala*, it is said that Vasiṣṭha, being unable to obtain *Siddhi* (i.e. attainment of miraculous powers) even after years of mutterings and severe austerities, at last pronounced a curse on the deity (Tārā). She, thereupon, appeared before him, and told him that by these austerities it was impossible to attain *Siddhi*, but it would be easy of attainment if he went to Mahācīna, in the country of the Buddhists and the land of the Atharva-veda. Vasiṣṭha thereafter repaired to Cīna-bhūmi, where Buddha was residing and was indulging in all sorts of loathsome practices. Vasiṣṭha was horrified to witness the scene, and appealed to Buddha to allay his doubts, and ultimately grant him the cherished *Siddhi*. He asked many questions regarding Buddha's use of wine and meat, and the presence of the women, entirely without dress, drinking blood and wine and behaving like drunkards, and he wanted to know why Buddha associated himself with these women. Buddha was not perturbed at these direct questions, but gave him a lecture on the duties of the Kaulas, and explained to him their mysteries and utility, and acquainted him with the secret rites and practices connected therewith. Vasiṣṭha was fully convinced and soon followed the ways of Buddha, and eventually attained final liberation by an unrestrained use of the five *Ma-kāras*. This is evident from the following verse :

ētac chrutvā gurōr vākyaṃ, smṛtvā dēviṃ sarasvatīm,
madirā-sādhanaṃ kartum jagāma kula-maṇḍapē :
madyam māṃsam tathā matsyam mudrām malthunam ēva ca,
punaḥ punaḥ sādhayitvā pūrṇa-yōgi babhūva saḥ.

(Hearing this word of his Teacher, and thinking of the Goddess Sarasvatī [i.e. Nīla-Sarasvatī, who is a form of Tārā], he went to the pavilion for *Kula* [or *Oakra*] gathering, to perform the wine-ritual. Continually performing the ritual with wine, meat, fish, gestures of the fingers and sexual commerce, he became a full *yōgi*).

Again in the *Brahma-yāmala* the same story is repeated, with slight modifications. It is there recorded that Vasiṣṭha, after coming to Mahācīna, became frightened and disgusted with the practices current there. He was terrified to see Buddha in a deeply drunken state, with a filthy smell coming from his mouth, and surrounded by thousands of women. Just at this time there was a voice from Heaven, which directed him to follow the custom and practices current in Cīna-bhūmi (the land of China), so that he might obtain final liberation, which was otherwise unattainable. Vasiṣṭha was mightily pleased to hear the mysterious voice from heaven, and went to the place where Buddha was; and, after being initiated by him, he speedily obtained liberation.

It is needless to point out that the Hindus considered the *Rudra-yāmala* and the *Brahma-yāmala* as Tantras of the highest authority, and, from their point of view, of highest antiquity. The evidence of these two Tantras and that of the *Tārā-tantra* clearly shows the Buddhist character of the deity and of the *mantra*.

In the original Sanskrit texts of the *Rudra-yāmala* and the *Mahā-cinācāra-krama*, there are certain details which are important. *Vaśiṣṭha* was doing his penances and performing the *Tārā* ritual at the shrine of *Kāmākhyā* in *Nīlācala* or the Blue Mountain, which is the shrine of the Mother Goddess at *Kāmākhyā* Hill east of Gauhati town in Assam, and this is a Śākta or Tantric place of pilgrimage of first-rate importance. Here the Mother is in the form of her *Yōni*, formed in the cleft of a rock over which the temple has been built. Evidently, *Vaśiṣṭha* at first performed his rituals in the worship of *Tārā* in the ordinary *Dakṣiṇācāra* or Rightist Way, i.e. the Brahmanical Way, and failed to obtain his objective, which was to gain miraculous powers over life. He felt angry and frustrated, and then *Tārā* manifested herself to him and asked him to go to *Mahācīna* and learn the right cult and ritual there from Buddha, viz. the *Cinācāra*; and if he followed that, he would succeed. So wishing to know the correct ritual (*ācāra-vijñāna-vāñchayā*) he went to *Mahācīna*, and there he saw beside the *Himālayas* the lord, 'well-served by *Lokeśvara*' or *Avalokiteśvara* (*lōkēśvara-suṣēvitam*), in the form of Buddha, surrounded by a thousand women who were young and handsome, with their zones tinkling, elated by wine, joyous through sportiveness, adorned in full decorations, alluring the world, devoid of fear and shame, and meditating on the Goddess. After obtaining the necessary instructions as to the *Cinācāra* ritual, he came back to the holy shrine of *Kāmākhyā* in *Nīlācala*, and there he performed the ritual. Evidently, in this way the *Cinācāra* form of *Vāmācāra* was established in Assam and India.

It is to be noted that close to the *Kāmākhyā* shrine in Assam, which is on the top of the hill known as *Nīlācala* to the west of Gauhati town (Gauhati is the site of the old capital of *Kāmarūpa* or Assam), a short distance to the east of the precincts of Gauhati, there is a place called *Vaśiṣṭhāsrama*, which is largely visited by pilgrims. According to tradition, it was the place where *Vaśiṣṭha* used to perform his worship, presumably of the Mother Goddess in the form of *Tārā*. So there is some geographical assignment, according to the Tantric tradition which cannot be brushed aside, to the *Vaśiṣṭha* legend, and the tradition can thus be localized.

In the light of all that has been said before, the historical core behind this story might be something like this. Ideas of Taoistic ritual, with women for the perfection of the *Yang* in men through commerce with the *Yin* in women—of the perfection of the Man or the *Purusha* by union with women as *Prakṛiti* or *Śakti*, to speak in the Indian way—were adopted in Indian Buddhist Tantrism in China, probably from the fourth century A.D. onwards. In the meanwhile, the *Tārā* cult, as a corollary of the Bodhisattva ideal and the *Śakti* ideal, developed in India, and spread into Tibet and into China. In China, *Avalokiteśvara* changed his sex, and in this way his *Śakti*, the white-robed *Tārā*, whose worship was introduced in China in the eighth century A.D. and he himself became merged into a single deity, the deity of Mercy, the Goddess *Kuan-yin*, who would quite naturally be regarded by uninformed Indians as *Tārā* herself. The very great vogue of the *Kuan-yin* cult in China could pass for *Tārā*-worship there, according to Indian ideas. Indian adepts, who were attracted by *Vāmācāra* as a new doctrine from China, may have gone from Assam to China, either by-passing Tibet, or going through Tibet. In Assam, there was already an interest in China and in Taoistic notions, from the seventh century at least (*vide* king *Kumāra Bhāskara*'s eagerness for an image of *Lao-tzū* and for a translation of the *Tao-Teh King*). Initiated in this *Cinācāra* or acquiring a knowledge of it on the soil of China, these Tantric adepts from India would come back and establish it as a new development

of Indian Buddhist Tantra, and establish centres in places like Kāmākhyā, which was famous as a Śakti shrine. Vasiṣṭha was just typical of one of these Indian adepts, who were responsible for the full establishment of the *Cinācāra* in Brahmanical Tantra, possibly in the ninth and tenth centuries A.D. In the case of the legend of Śāmba going to Śākadvīpa and bringing the Iranian cult of Sun-worship (Mihira-worship) from there into India, we are told that Iranian Magi—*Maga-Brāhmaṇas* as they came to be known in India (or *Śākadvīpīya Brāhmaṇas*, or *Graha-vipras* because of their knowledge of the planets and other astronomical bodies—came to India as ministrants of the cult and settled down and became absorbed in the Hindu people as a special class of Brahmans. But it is not known if actually any Chinese teachers of the cult came to India in a similar way. If they did, they could be expected to have come only as Buddhist Tantrics practising *Vāmācāra*, which became specially designated in India as *Cinācāra*.

It was in this way that China, during the first 800 or 1,000 years after the Christian era, exerted a very powerful influence on India in the domain of religion, by giving to India her Taoist practices for the attainment of *Hsien*-ship, which were given admission into the Indian scene as the *Vāmācāra* or the Leftist Ritual, and which people knew to be a *Cinācāra* or Chinese Ritual.

THE QUESTION OF NUMERICAL NOTATIONS: PLACE-VALUE AND THE ZERO

In the third volume of his great work, from which quotations have been made above (Cambridge, 1959), dealing with the development of 'Mathematics and the Sciences of the Heaven and the Earth' in China, Dr. Joseph Needham has in his objective way made some suggestions about a very likely mutual influencing, if not actual co-operation or collaboration, between India and China in a most vital and basic matter in Mathematics, viz. the numerical notation and the zero concept, and the representation of the zero by a dot or circle in numerical notation.*

The decimal notation, with place-values for the digits and with the sign zero, is something which revolutionized the mathematical science, first in India and then in the Arab World and Europe. The old Greek and Roman notation with letters of the alphabet for certain numerical values, and the similar *Abjad* system in Arabic, retarded the progress of mathematics. The Arabs borrowed the decimal system as it was fully developed and in general use in India in the early medieval period, and they borrowed the Indian numerical figures for 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. These they called *Raqam al-Hind* or 'Indian Figures'. Then in the twelfth century European peoples took them over from the Arabs, and called them 'Arabic Figures', as opposed to the earlier Roman.

But in India, the full use of the decimal notation with the zero figure was rather late—it cannot be traced earlier than the sixth century A.D. Previously, numbers were indicated in India in a rather cumbrous way. Thus, in an Asoka inscription, third century B.C., the figure 256 was indicated by three signs, say *ABC*, where *A* stood for 200, *B* for 50, and *C* for 6. There was no sign for the zero, although there were in the Brāhmī alphabet, the national script of Ancient India, from pre-Christian times

* This matter was brought to my notice by a European delegate to the 25th International Congress of Orientalists in Moscow who spoke to me about it and then sent me a note when I was speaking on the subject in the Indian Section, and I regret very much I could not contact him again.

separate signs for all the numerals from 1 to 9. After 9, 10 was indicated by a single sign, and 11 by that single sign for 10 followed by 1; 20 by another single sign, 30 to 90 by different single signs—not by giving a place-value to the digits to indicate multiples by 10. So 100, 200, 300, 1,000, etc., were denoted by single signs all independent of each other.

How the place-values came to be established in India, and under what circumstances the zero sign was evolved, is lost in the mists of unrecorded history. But once, during the middle of the first millennium A.D., the place-value idea and the invention of the zero symbol gave birth to the pure decimal notation, it became immediately accepted, and it passed out of India to the West also. But one curious thing is to be noted. Not all parts of India wholly or exclusively adopted the new decimal system with the zero: It was adopted in North India, almost entirely. But in South India, until very recent (post-British) times, the old system of having separate single signs for 10, 20, 30, 100, 1,000, etc., continued. The decimal notation with the zero somehow did not make a sweeping conquest of the *intelligentsia* there. When mathematics was being taught in schools in South India—in the Tamil, Malayalam, Kannada and Telugu areas—through English, the decimal notation with English or European figures came to be adopted, and the cumbrous earlier non-decimal system with the native Tamil, Telugu and other figures fell into disuse: so much so that with the decimal system, the European figures for the numerals were adopted in Tamil, Malayalam, Kannada and Telugu. (This is the reason why South Indian numbers of the Constituent Assembly insisted in 1949 on the adoption of the European numerical figures in Hindi in Nagari characters as the official language of India beside English, to the complete exclusion of the Nagari figures for the numerals).

Two things are involved in the establishment of the decimal notation: (i) place-values for the digits, and (ii) the zero sign. Neither of these was known or in use in India before the sixth century A.D. Dr. Needham in his book (Vol. III, p. 12) says:

In an inscription at Phnomp̣bayān in Cambodia for A.D. 604, the 526th year of the Śaka era was expressed as 'the year (designated by) the (five) arrows, the (two) Aśvins and the (six) tastes'. Now it is soon after this period that the first inscriptions appeared showing the zero (simultaneously in Cambodia and Sumatra, A.D. 683; and at Banka Island, A.D. 686). The 605th year of the Śaka era is represented as ६०५ using a dot (*bindu*) and the 608th as ६०८, showing the modern zero itself. [I have used here Nagari numerals, as equivalents of Cambodian and Old Javanese numerals given by Dr. Needham, as a typographical convenience]. The Indian numerals, without the zero, and encumbered with separate signs for the multiples of 10, were no improvement at all on the Greek and Hebrew alphabetical scripts. Yet Indo-China would seem at first sight a rather unlikely place for such a revolutionary discovery as that of the essentially liberating element.

Cœdès does not believe that the South-East Asian inscriptions indicate an East Asian origin for the symbolic word system (as Kaye had hinted might be possible), but rather that the Hinduising settlers of South-East Asia already had symbolic words and the old numerals when they first went there, or at any rate were soon followed by them. So far so good, but we are free to consider the possibility (or even probability) that the written zero symbol and the more reliable calculations, which it permitted, really originated in the Eastern zone of Hindu culture where it met the Southern zone of the culture of the Chinese. What ideographic stimulus could it have received at that interface? Could it have adopted an encircled vacancy from the empty blanks left for zeros on the Chinese counting-boards? The essential point is that the Chinese had possessed, long before the time of the *Sun Tzu Suan Ching* (late third century A.D.) a fundamentally decimal place-value system. It may be, then, that the 'emptiness' of the Taoist mysticism, no less than the 'void' of Indian philosophy, contributed to the invention of a symbol for *śūnya*, that is the zero. It would seem indeed

that the finding of the first appearance of the zero in dated inscriptions on the borderline of the Indian and Chinese culture-areas can hardly be a coincidence.

Dr. Needham further mentions that the use of the zero in the Indian system of calculation is attested by a Chinese astronomical work composed between A.D. 718 and 729. In the absence of more detailed information, are we to assume that it suggests that the use of the zero struck the Chinese as something new in mathematics, which came from India?

With regard to the zero concept and the zero symbol, the following observations of Dr. Needham are to be noted:

Two different things are involved here, though so closely connected. Place-value could and did exist without any symbol for zero, as in China from the late Chou onwards. But the zero symbol, as part of the numerical system, never existed, and could not have come into being, without place-value. It seems to be established that place-value was known to, and used by, the author of the *Paulisa Siddhanta* in the early years of the fifth century A.D., and certainly by the time of Aryabhatta and Varaha-Mihira (c. A.D. 500). And this was the decimal place-value of earlier China, not the sexagesimal place-value of earlier Babylonia. It may be very significant that the older literary Indian references simply used the word *śūnya* 'emptiness', just as if they were describing the empty spaces on Chinese counting-boards. The earliest zero symbol used in computation, the dot (*bindu*), occurs in the Bakhshali MS., but this cannot now be dated earlier than tenth century A.D. Better evidence for the use of the dot comes from the sixth century A.D. poem *Vāsavadattā* of Subandhu. This remains the earliest reference. The dot is still used in the Sarada script of Kashmir.

Dr. Needham seems to suggest some mutual influencing or collaboration between India and China in evolving the zero—China giving the concept of the place-value in numerical notation, which goes back in China to Chou times, and India supplying the zero symbol; and this collaboration might well have taken place, as Dr. Needham suggests, in 'the Eastern zone of Hindu culture, where it met the Southern zone of the culture of the Chinese'.

But actually, the concept of the zero is found in the mainland of India, as the literary references given by Dr. Needham himself would show. Dr. Dinesh Chandra Sircar, Director of Epigraphy in the Archaeological Survey of India, to whom I referred the matter, tells me that the oldest use of the decimal notation in India is found in an inscription from Baroda State in Gujarat (Western India) dating from A.D. 594 (the date given is the Kalachuri year 346, written in decimal notation. I give below what he writes (in a letter dated 13th September, 1960):

The earliest use of the decimal system of writing numbers is noticed in the Sankheda (old Baroda State) inscription of the Kalachuri year 346 (written in decimal figures and not in symbols as $300+40+6$) corresponding to A.D. 594, while the earliest use of zero is found in Eastern Ganga records of the Ganjam-Chicacole region like the Chicacole plates of the Ganga year 183 (c. A.D. 680) and the Sudava plates of the Ganga year 204 (c. A.D. 701). See *Epigraphia Indica*, Vol. II, p. 20 (346 written in decimal figures); *ibid.*, Vol. III, plate facing p. 133, text line 27 (20 written with zero following 2, although the printed text is inaccurate); *ibid.*, Vol. XXVI, plate facing p. 67, text line 31 (204 written with the figures for 2 and 4 having the zero between them). The language of all these records is Sanskrit.

This would show that the zero and the decimal notation originated in India, in the sixth century A.D. at the latest: it might be earlier still. But what Dr. Needham has said in this connexion is quite pertinent, and noteworthy (p. 15 of Vol. III of his work):

It will thus be seen that behind the 'Hindu' numerals, as the West subsequently knew them, there lay 2,000 years of place-value in China.

So in the absence of other evidence, we might postulate Chinese and Indian collaboration here. Place-value for signs for the numerals from

1 to 9, but no zero, in China from the Chou period (thirteenth century B.C.); and the zero symbol in India, from the sixth century A.D.

This is all that we can say now.

There are other matters relating to mathematics, e.g. negative numbers, indefinite equations, etc., and to astronomy, besides medicine, where mutual influences are likely. But these must await further comparative study, even after Dr. Needham's *magnum opus*.

CONCLUSION

It would thus appear that in the ten or twelve centuries of close contact between India and China, India also took a number of objects as well as ideas from China. It is customary to condemn outright Tantric practices and *Vāmācāra*. But this form of Buddhism and Brahmanism deserves, to say the least, a full historical survey, apart from an appraisal of its ideological and religious aspects. The late Sir John Woodroffe, formerly a Judge of the High Court of Calcutta, and well known to the scholarly world by his sobriquet of *Arthur Avalon*, for his translations into English and for his interpretations of some great Brahmanical Tantras and of Tantric lore and practices and philosophy, was convinced about the philosophical and spiritual values of the Tantra, including even certain aspects of it, which are generally condemned outright without proper study and understanding. The scientific implications of Chinese Taoistic ideas and practices and their Indian Tantric developments and parallels have been clearly indicated by Dr. Joseph Needham, and we should stop at that. The influences of India and China were not one-sided, but mutual, and in the plane of ideas also. India could give, but she could also take: and that is the great teaching of history which should not be missed.

It is perfectly certain that in matters like these, a closer Sino-Indian co-operation in the field of comparative studies in literature, art, religion, ritual and philosophy as well as science is still awaited by the world of modern scholarship, and awaited with great interest and hope of achieving some positive results. And Western scholarship, which initiated this enquiry, is bound to be there and help, and co-ordinate in a world-context, at least for the time being.

The scientific and literary co-operation between India and China for more than a millennium is one of the most instructive and inspiring chapters in the history of early international relations. It is the bounden duty of scholars, both in India and in China, to pick up the lost threads of this co-operation, and along different lines of investigation which were not known in ancient days, to pursue the story of this international co-operation, directly in the domain of philosophy and religion, and indirectly in that of science.

REVIEWS OF BOOKS

THE EPISTEMOLOGY OF DVAITA VEDĀNTA by Dr. P. Nagaraja Rao.
Published by The Adyar Library and Research Centre, Adyar, Madras,
India. December, 1958. Pages viii+120.

The charge is often heard against Indian philosophy that its theories are not based on independent reasoning and, therefore, they are dogmatic, rather than critical. This charge is clearly not true of the majority of the Indian systems which are as much based on critical thinking as any we can find in the West in this modern age of critical speculation. The criticism may be chiefly levelled against the two systems of the Mīmāṃsā and the Vedānta which give an important place to the authority of the Vedas and are direct continuations of the ritualistic and speculative aspects of Vedic culture respectively. But though these systems start from authority, the theories they develop are supported by such strong independent arguments that even if we withdraw the support of authority, the theories can stand well and compare favourably with any theory established elsewhere on independent reasoning alone. That the arguments in favour of the theories of the Indian systems are logically valid and sound is sought to be shown in every Indian system by basing its philosophical views on a thorough epistemological enquiry. This is as much true of the Mīmāṃsā and the Vedānta as of any other Indian system of philosophy. Every Indian system of metaphysics is based on its own epistemology, i.e. its theory of the nature, forms and sources of valid knowledge, its theory of truth and error, and of the range and limits of ordinary empirical or rational knowledge.

The Dvaita Vedānta of Madhva has its own epistemology just as the Advaita of Śaṅkara and the Viśiṣṭādvaita of Rāmānuja have theirs. The present work of Dr. P. Nagaraja Rao, under review, is a brief but reliable account of the epistemology of Dvaita Vedānta. It is based on the *Pramāṇapaddhati* of Jayatīrtha, which is an independent manual of the epistemology of Madhva's philosophy just as the *Vedāntaparibhāṣā* is of Advaita. The author has also freely drawn from the other works of Jayatīrtha, like *Nyāyasudhā*, which are commentaries on Madhva's works. The exposition of Dvaita epistemology given in the book is critical and comparative throughout. It treats of the various aspects of Madhva's theory of knowledge and compares them with the corresponding theories of other Indian systems and gives a critical estimation of them.

The book contains eight chapters with an Introduction. The first chapter deals with the concept of definition, the second with the *pramāṇas* or sources of valid knowledge of which Madhva recognizes only three, namely, perception, inference and verbal testimony. Chapter III discusses the knotty problems of error, doubt and dream. In Chapters IV to VII, we find a fairly comprehensive account of perception, inference and verbal testimony as *pramāṇas* and as including the other *pramāṇas* recognized in some other systems of Indian philosophy. Chapter VIII discusses the general problem of the validity of knowledge and the theories of intrinsic and extrinsic validity (*svataḥ* and *parataḥ prāmāṇya*), and summarizes the distinctive contributions of Madhva to the theory of knowledge. There are two appendices on 'the category of difference in Vedānta' and 'God in Dvaita Vedānta' at the end, which add to the value of the book.

The exposition of the epistemology of Dvaita Vedānta in the book is clear, concise and adequate on the whole. There are, however, some defects in the translation of Sanskrit philosophical terms into English, and one misses the corresponding Western philosophical terms at certain places. Still, the book is a valuable contribution to Indian philosophical literature in English and makes useful and interesting reading from beginning to end. It will help uninformed critics to realize that Indian systems of philosophy are neither dogmatic nor a mere elaboration of religious faith and revelation.

S. C. CHATTERJEE.

THE HISTORY OF THE GĀHAḌAVĀLA DYNASTY. By Roma Niyogi, M.A., D.Phil., Calcutta, 1959. Pp. i-xvi + pp. 1-283. Price Rs.15. Published by Calcutta Oriental Book Agency, Calcutta 9.

This treatise is a detailed history of the Gāhaḍavāla dynasty of kings who ruled in the Antarvedi region of India during parts of the eleventh century A.D. and almost the whole of the twelfth. The work consists of eight chapters, in the first five of which the learned authoress, Dr. Roma Niyogi, M.A., D.Phil., has dealt with the political background of the history of this dynasty and the origin of the Gāhaḍavālas, and their political history. In Chapter VI she has tried to classify and discuss the geographical data supplied by epigraphic records of the kings of that dynasty. The next two chapters (Chapters VII and VIII) form a review of the administrative, social, religious and cultural matters, so far as they can be drawn out from the inscriptional literature available on the kings of this dynasty. The book also contains four important Appendices.

The whole volume is a welcome addition to some of the Indian regional histories which are already extant in the field of Indian history. Dr. Niyogi's treatise is chiefly based on the inscriptions of the Gāhaḍavāla kings and the *Kṛtyakalpataru* of Lakṣmīdhara. There can be no doubt that Dr. Niyogi has bestowed many a year's hard labour on an intensive study of the materials culled by her from epigraphic and other sources for the preparation of this book, the merit of which is laudable enough. It is a very good and hopeful sign of the times that our young scholars, both male and female, not only in West Bengal but also in other Indian States, have taken to intensive and detailed study of the regional sections of India in ancient and mediaeval periods of her history. It is quite true to say that when all such studies will be co-ordinated in future, we may expect to have an adequately whole view of the cultural unity prevailing even in earlier days, both in the north and the south of India, and thus our modern political and cultural unity will have chance of being greatly developed. In this respect Dr. Niyogi's present treatise will be regarded as of great historical and cultural value to students of Indian history. Although the structure built by the learned doctor is based on rather scanty materials, the latter are, however, hard and well laid and there is no fear of its toppling down.

Dr. Niyogi, to her great credit, has dealt with the origin of the Gāhaḍavāla dynasty in a scholarly and splendid manner. She has fared well in reconstructing the history of King Govindacandra's kingdom, and the battle of Candwar during the reign of Jayaccandra has been critically described by her. It may only be wished that her researches into the geographical data (in Chapter VI) should not have formed a separate chapter by themselves in the main part of the present volume, but should have been

treated in a big Appendix attached to it. The explanation and interpretation of certain technical terms discussed in Chapter VII may not be taken as final, and they may sometimes invite criticism from scholars either in support or refutation of her own views which, however, cannot be called imaginary at all.

A comparative study of the administrative, social, religious and cultural matters as treated by Dr. Niyogi and those obtained from the records of the last few Pāla kings of Bengal and of almost all the Sena kings would have been extremely welcome, as the history of the Gāhaḍavāla kings synchronizes with that of the Pālas beginning from Rāmapāla and ending in that of Lakṣmaṇasena.

There are certain mistakes in the use of diacritical marks in some of the Sanskrit words written in Roman characters.

Dr. Niyogi is very surely worthy of congratulations from scholars for her useful treatise on *The History of the Gāhaḍavāla Dynasty*.

RADHAGOVINDA BASAK.

STUDIES IN ARABIC AND PERSIAN MEDICAL LITERATURE, by Prof. M. Z. Siddiqi. Published by the Calcutta University, 1959, with a Foreword by Dr. Bidhan Chandra Roy. It has 162 pages and 11 illustrations. The illustrations give an idea of former medicine and are exceptionally clear. The plate of Caesarean section in which a living child is extracted from a mother who is dead, is interesting.

The history of medicine has come to the forefront these days, and this book is very timely.

The book contains glimpses of Greek, and Indian medicine and medicine during the Abbaside period. The descriptions of former hospitals and illustrations are illuminating; a brief description of the nurses is also present. Medical knowledge in the Koran such as embryology, physiology, therapeutics and hygiene has been mentioned.

Many pages are given to appendix which also serve as a vocabulary. Firdausul-Hikmet described as the first independent Arabic compendium is treated in detail, and its writer Ali b. Rabban is discussed in detail, even the religion of his father whether he was a Jew or a Christian is mentioned. The medical men of old were very versatile, they were philosophers, artists, astronomers and even engineers. Leonardo da Vinci is an example. Mian Bhowa who was very much interested in Indian music and Indian medicine has also been referred to.

A long list of errata is appended, but is not complete.

The book is well got up and will serve a useful purpose in medical studies.

H. HYDER ALI KHAN.

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ŚĀSANADEVĪS IN THE KHANDAGIRI CAVES

By DEBALA MITRA

Two caves, locally known as Navamuni and Bārabhuji, in the Khandagiri, Orissa, are remarkable for the reliefs of the Jaina *śāsanadevīs*, carved below their respective *tīrthaṅkaras*. Originally dwelling cells, both were converted in the mediaeval period into sanctuaries with slight alterations like excavation of their floors to deeper depths and addition of the reliefs of the *jīnas* with *śāsanadevīs*. Of the two, the first, containing the reliefs of seven *śāsanadevīs*, has an inscription dated in the reign of the Somavamśī king Uddyotakesari (*circa* eleventh century).¹ Stylistically, however, the reliefs seem to be earlier in date. The other cave, called Bārabhuji on account of the representation of a twelve-armed *śāsanadevī* on each side wall of the verandah, contains the reliefs of twentyfour *śāsanadevīs* on the three walls of the cave, in addition to the two in the verandah. These reliefs are definitely later than those in the Navamuni and may even be as late as the eleventh-twelfth century A.D.

Curiously enough, the reliefs, with the exception of Āmrā, do not, as a rule, follow the canons of iconography as laid down in the available scriptures. This indicates either the existence in this region of a different text which the artist followed in carving the reliefs of the *śāsanadevīs* or the germinal state in which iconographic concepts still existed without being crystallized into rigid forms. The latter alternative is suggested by the difference in the attributes of the same *śāsanadevī* not only in two caves, but also in the same cave.

The sculptures have thus a definite place in the history of Jaina iconography. I, therefore, give below the main characteristics of the *tīrthaṅkaras* and their *śāsanadevīs*, specially the latter. In the description the names used by the Digambaras are followed, as figures of the *jīnas*, wherever they are carved standing, are invariably represented as robeless, no doubt showing that the caves belonged to the Digambara sect.

NAVAMUNI-GUMPHĀ

On the back wall of what was originally the right cell of this cave are carved in fairly high relief seven *tīrthaṅkaras*, seated cross-legged with both soles visible in *yoga-mudrā* (one palm resting above the other on the lap) within niches rounded at the top. Over their heads are the canopies of three-tiered umbrellas flanked by a pair of hands playing on cymbals. On either side of the *tīrthaṅkaras* are standing fly-whisk-bearers wearing *kaupīnas* (loin-cloth). Though the figures are greatly weathered on account of coarse-grained texture and brittle nature of the stone, they display considerable workmanship. The varied treatment of the coiffure is specially noteworthy. Some of them have their *jaṭās* tied and folded on their heads and others have them arranged in the shape of a cone, while Neminātha has his spiral curls arranged in a top-knot like that of Buddha. None of them have any halo behind them. Nor have they any *śrivatsa* mark on their chest.

¹ *Epigraphia Indica*, Vol. XIII (1915-16), pp. 165-166.

Below each *tīrthaṅkara* is his *sāsanadevī*, executed in medium relief. Preceded by the figure of Gaṇeśa, seated in *mahārājalīlā*, holding a bowl of *laḍḍukas* (on which his trunk is applied), hatchet (*paraśu*), rosary and radish (Pl. I), the seven *sāsanadevīs* are reminiscent of the Brahmanical *sapta-matrikās*. The grouping may not be accidental, as most of them evince characteristics which are not available in the Jaina texts but which occur in their Brahmanical prototypes. With their attributes and mounts they disclose unmistakably the assimilation of the Brahmanical deities into the Jaina pantheon. All of them are clad in *dhotīs* and short diaphanous scarfs, placed obliquely along their chests and left shoulders.

Beginning with the left:

1. Rishabhanātha with his cognizance, bull, carved below his lotus-seat. His *sāsanadevī* is Chakreśvarī seated in *yogāsana* (cross-legged with both soles visible) on a plain seat, below which is her mount Garuḍa with folded hands and a crane. Decked in bangles, a *hāra*, *kundalas* and *jaṭā-mukuta*, she is ten-armed, six with flower-like *chakras* perched on the fingers of six hands, the seventh hand holding a perforated disc, eighth a shield, ninth a rosary held against her chest in *vitarka-mudrā* and the tenth placed on the lap in *yoga-mudrā*. The conception of this goddess has much in common, both in name and attributes, with that of the *śakti* of Viṣṇu. (Pl. IA.)

2. Ajitanātha with his cognizance, elephant, below his lotus-seat. His *sāsanadevī*, four-armed Rohiṇī, bejewelled with bangles, a necklace, ear-studs, anklets, and *kirīṭa-mukuta*, is seated in *lalitāsana* on a plain seat, below which is an elephant. Her lower right hand is in *abhaya* and upper holds a *vajra*. Of her two left hands, one carries a goad and the other a three-pronged object. The attributes in her hands and also the elephant (which is not the mount of Rohiṇī) connects her undoubtedly with the *mātrikā* Indrāṇī, the *śakti* of Indra. The third eye, placed horizontally over her forehead, strengthens this conclusion. (Pl. IB.)

3. Sambhavanātha with his damaged cognizance, horse, below his lotus-seat. His *sāsanadevī*, Prajñapti, is two-armed, holding in her left hand the stalk of a blue lotus, right being in *abhaya*. Seated in *lalitāsana* on a double-petalled lotus, she wears a necklace, bangles, anklets and a plain *jaṭā-mukuta*. The attributes in her hands do not agree with those prescribed in texts. (Pl. IB.)

4. Abhinandana seated on a legged seat, below which is a monkey. His *sāsanadevī*, who is known as Vajraśrīṅkhalā, is shown seated in *lalitāsana* on a plain seat below which is a monkey with folded hands. Decked in bangles, necklace, ear-studs, *kirīṭa-mukuta* and anklets, she carries in her lower left a child, in upper left a conch and in upper right a *chakra*, the lower right being in *abhaya*. With her attributes she is nearer the *mātrikā* Vaiṣṇavī than Vajraśrīṅkhalā. The artist has given her the cognizance of her *jina* instead of the canonical swan. (Pl. IIA.)

5. Vāsupūjya with buffalo (mostly damaged) below his *śimhāsana*. His *sāsanadevī*, Gāndhārī, is seated in *lalitāsana* on a plain seat below which is a peacock. Wearing bangles, a necklace, ear-studs, anklets and a *jaṭā-mukuta*, she holds in her lower left a child, in upper left a *śakti* and in upper right a *mātulaṅga*, the lower right being in *abhaya*. Neither the attributes nor the mount tally with scriptural prescription. She is a downright borrowing from the Brahmanical Kaumārī. (Pl. IIA.)

6. Pārśvanātha under a seven-hooded canopy on a double-petalled lotus, with a flower below. On either side of his lotus-seat is a three-hooded *nāga*, his distinctive cognizance. Padmāvatī, his *śāsanadevī*, sits here in *lalitāsana* on a double-petalled lotus, below which are the representation of a lotus and a crude beaked figure. Decorated with bangles, a *hāra*, ear-studs, a *jaṭā-mukuta* and anklets, she holds in her left hand a lotus, right being in *abhaya*. She is endowed with a third eye placed vertically over the forehead. (Pl. IIB.)

7. Neminātha on a plain seat. On either side of the latter is a conch on a lotus. Ambikā or Āmrā, his *śāsanadevī*, sits in *lalitāsana* on a plain seat with her cognizance lion (mutilated) below. Above the niche is the representation of a mango-tree. Decked in bangles, a *hāra*, *kuṇḍalas* and *jaṭā-mukuta*, she holds in her left hand a child and in her right a bunch of mangoes. On the left side is a nude standing male, with raised left hand and holding in his right hand an uncertain object. (Pl. IIB.)

On the right wall there are two reliefs, one of Pārśvanātha and the other of Rishabhanātha, both seated in *yogāsana* on a lotus flanked by fly-whisk-bearers. Pārśvanātha, seated under a seven-hooded canopy, is distinguished for his bejewelled *jaṭā-mukuta*. On either side of the canopy is a flying figure holding a garland. Beneath the lotus-seat is a *ghaṭa* flanked by a *nāga* figure. Rishabhanātha has a halo round his head. Below his seat is his cognizance bull. The relief is unfinished and may not be contemporary with the main group.

On the left wall is carved a small figure of Chandraprabha seated on a lotus, below which is the representation of the moon. His spiral curls are arranged in a top-knot.

BĀRABHUJĪ-GUMPHĀ

There are altogether twentyfive figures of the *tīrthaṅkaras*, Pārśvanātha being repeated twice evidently on account of his higher sanctity. Of the two figures of Pārśvanātha, one is in its usual position in the group; the other occupies the first place on the back wall. The latter is larger in size than the rest and is shown stripped of all raiments, standing in *kāyotsarga* pose, with its long hands hanging by its sides, on a double-petalled lotus under the seven-hooded canopy of a serpent. Above its head are a three-tiered umbrella, cymbals beaten by hands and flying figures holding garlands. On its either side are a three-hooded *nāga* seated with folded hands and a standing fly-whisk-bearer, one above the other. The figure of the *śāsanadevī* is absent. Pārśvanātha evidently occupies the position of the *mūla-nāyaka* in this cave.

The rest of the figures of the *tīrthaṅkaras* are seated cross-legged with feet resting on thighs (*yogāsana*), on double-petalled lotuses supported by lions, in *yoga-mudrā* beneath the trees under which they attained their *kevala-jñāna* (supreme knowledge); above their heads is a three-tiered *chhatra* (umbrella), one of the eight *pratihāryas*. Flanked on either side by an attendant holding a fly-whisk, all, except Pārśvanātha, have a halo round their heads. Celestial music is indicated by cymbals played by hands of invisible persons; near these are two flying figures holding garlands. The general appearance of all these figures is the same as if they were cast in the same mould. But for their distinctive *lāñchhanas* carved below their lotus-seats they would have been passed for only one *tīrthaṅkara*. The *śrīvatsa* mark is conspicuous by its absence on the chests of the *tīrthaṅkaras*.

Beneath the *tīrthaṅkaras* are, in separate compartments, their respective *sāsanadevīs*, all of whom, excepting Mahāmānasī, who is in *yogāsana*, and Bahurūpiṇī, who is lying down, are seated in *lalitāsana*. Twenty of them are on legged seats and four, the fourth, sixteenth, twentysecond and twentythird, on lotus, below which are their animal-mounts. All, except Bahurūpiṇī and Padmāvatī, the latter with a canopy of snake, have halo behind their heads. Draped in *dhotīs*, they are all decked in ornaments like *bangles*, *hāra*, ear-ornaments, *mekhalā*, *jaṭā-mukuta*, etc.

On the left wall are the first five *tīrthaṅkaras*, with their *sāsanadevīs*, preceded by an unfinished figure in *yoga-mudrā*. Beginning with the left :

1. Rishabhanātha with his cognizance bull (*vrisha*), below whom is a twelve-armed Chakreśvarī with her cognizance Garuḍa. Of her six right hands one is in *varada* and the rest hold a thunderbolt (*vajra*), two discs (*chakra*), rosary (*aksha-sūtra*) and a sword; three of her left hands hold a shield, disc and the stalk of a flower, the attributes of the three others, one resting on her knee and the second placed on chest akimbo, are badly damaged. The available texts prescribe for the twelve-armed variety two *vajras*, eight *chakras*, a fruit and *varada*. (Pl. IIIA.)

2. Ajitanātha with elephant (partly damaged). The representation of the twelve-armed *sāsanadevī*, Rohiṇī, does not agree with that of the texts where she is invariably four-armed. One of her right hands is in *varada-mudrā*; among other attributes only spear, arrow and sword are recognizable. Her left hands hold a noose (?), bow, *hala*, shield, stalk of a lotus and *ghaṇṭā* (?), the last held against her chest. Her mount is a bull. (Pl. IIIA.)

3. Sambhavanātha whose cognizance (horse) is broken. Prajñapti is four-armed, with the lower right in *varada* and the upper right holding a rosary. The attributes in the left hands are not identifiable. Her mount is damaged; but it is definitely an animal and not a bird, as enjoined in the Digambara texts. The representation tally more with the textual description of the four-armed Śvetāmbara Dūritāri than with that of the Digambara Prajñapti, who is described as six-armed. (Pl. IIIA.)

4. Abhinandana with ape (*plavaga*). The textual description of the four-armed Vajraśṛiṅkhalā riding on a swan does not agree with the present representation of the *sāsanadevī*. Seated on a lotus, which has been prescribed for the four-armed Śvetāmbara Kālī, she is eight-armed with two hands playing on a harp (*upaviṇā*). One of her right hands is in *varada-mudrā*. Among other attributes, only *vajra* in one of her left hands is clear. (Pl. IIIA.)

5. Sumatinātha whose cognizance looks like an animal, though he is associated with a curlew (*krauñcha*). Ten-armed Purushadattā is a departure from the scriptural descriptions. Among the attributes in her right hands, *varada*, a perforated disc, long spear and sword are clear; in her left hands are a noose, shield, *hala*, hammer and blue lotus. Her mount is a crocodile (*makara*). (Pl. IIIA.)

6. On the back wall are represented seventeen seated *tīrthaṅkaras* with their *sāsanadevīs*, besides the standing figure of Pārśvanātha who stands first in the row. Next to Pārśvanātha is Padmaprabha with his cognizance lotus (*abja*). The representation of Manovegā is a deviation from the canonical injunction. Four-armed, she holds in her left hands a conch (?) and banner and in the upper right a three-pronged object

(*vajra* ?), lower right being as usual in *varada*. The cognizance is a swan and not a man or horse as enjoined in the Śvetāmbara and Digambara texts respectively. (Pl. IIIB.)

7. Supārśvanātha. The six-petalled symbol below his seat can in no way be termed as *svastika*. Neither the cognizance nor the attributes of Kālī correspond to those mentioned in the texts. Eight-armed, she has the *vara*, a bowl of fruits, lance (?) and sword in her right hands and a shield, conch, hammer (?) and *śūla* in her left hands. The mount looks like a peacock. (Pl. IIIB.)

8. Chandraprabha with the symbol moon (*śaśī*). The representation of Jvālāmālīnī or Jvālīnī has little affinity with the textual description. Twelve-armed, she has the *vara*, a *kṛipāna*, disc, arrows, club (?) and sword in her right hands and the *vara*, a shield, bow, conch, noose and bell (held against her chest) in her left hands. The mount is a lion. (Pl. IIIB.)

9. Pushpadanta (also known as Suvidhinātha) with a poor representation of *makara*, his cognizance. The number of hands with the attributes of Mahākālī does not agree with the textual description. Ten-armed, she has the *vara*, a disc (?), bird, bowl of fruits (?) and disc (?) in her right hands and a crescent, the *tarjanī-mudrā*, a snake, flower (?) and branch of a tree (or the feather of a peacock) in her left hands. She has, like the Śvetāmbara Sūtārā, a mount in bull. (Pl. IVA.)

10. Śīṭalanātha whose *śrīvatsa* cognizance is partly damaged. The four-armed Mānavī holds in her lower left a *daṇḍa*, lower right being in *varada*. The attributes in the upper hands are indistinct; that in the upper right looks like a disc, while the object in the left may either be a conch or fruit. Her cognizance, an animal, is damaged. (Pl. IVA.)

11. Śreyāmsānātha with the cognizance rhinoceros (*khaḍgī*). Gaurī is four-armed, holding in her left hands water-pot and manuscript and upper right rosary, lower right being in *varada*. Her attributes connect her with the Brahmanical Brahmanī. The major portion of the body of the animal together with the head is broken. Heavy-bodied, it is neither an antelope, as prescribed in the Digambara texts, nor a lion of the Śvetāmbara Mānavī or Śrīvatsā. (Pl. IVA.)

12. Vāsopūjya with buffalo (*mahisha*). The eight-armed Gāndhārī has the *varada*, a *mātulunga* (?), rosary and blue lotus in her right hands and a water-pot, conch, twig or bunch of flowers and the stalk of a full-blown lotus in her left hands. Her mount here represented is a bird. (Pl. IVB.)

13. Vimalanātha with boar (*śūkara*). Vairoṭī is eight-armed, having the *vara*, an arrow, sword and *paraśu* in her right hands and a *vajra*, bow, *śūla* and shield in her left hands. Her mount is a crane. (Pl. IVB.)

14. Anantanātha whose cognizance looks more like a porcupine than a hawk (*śyena*), as enjoined by the Śvetāmbaras or bear by the Digambaras. The eight-armed Anantamatī holds in her left hands a long staff-like object, *vajra*, stalk of a full-blown lotus, hammer and shield. Among the attributes in her right hands, the *varada*, a small dagger, spear and sword are identifiable. Her mount looks like a donkey, head broken. (Pl. IVB.)

15. Dharmanātha with thunderbolt (*vajra*). The six-armed Mānasī has in her right hands the *vara*, pellet and a three-pronged object (?) and in her left hands a *ghanṭā*, banner and conch. The head of the animal, which looks like a camel, is damaged. (Pl. IVB.)

16. Śāntinātha with his cognizance antelope (*mṛiga*). Seated cross-legged on a double-petalled lotus, Mahāmānasī holds in her two hands the stalks of two full-blown lotuses on which are perched two elephants pouring water from pitchers over the *śāsanadevī*. The representation agrees more with the conception of the *abhisheka* of Lakshmī than the canonical description of the *śāsanadevī* of Śāntinātha. (Pl. IVB.)

17. Kunthunātha with goat, latter's head broken. The ten-armed Jayā or Vijayā has in her right hands the *vara*, a staff-like object, hook (*ankuśa* ?), disc and rosary (?) and in her left a three-pronged object, perforated disc, conch (?), stalk of a full-blown lotus and water-pot. The animal is a buffalo, partly damaged. (Pl. VA.)

18. Aranātha with fish. Holding in her left hand the stalk of a blue lotus and with right in *varada*, the two-armed Tārā is a wholesale adaptation from the Buddhist goddess Tārā. The name itself betrays unmistakable identity with that deity. The head of the animal, which looks like an elephant, is broken. (Pl. VA.)

19. Mallinātha with his cognizance water-pot (*ghaṭa*). The *śāsanadevī*, Aparājītā, is eight-armed, holding in her right hands the *vara*, a long spear (*śakti*), arrow and sword and in her left a cone-shaped object (*saṅkha* ?), bow, shield and banner. The short-tailed animal with an equine head is partly damaged. (Pl. VA.)

20. Munisuvrata with tortoise (*kūrma*). The two-armed Bahurūpiṇī is shown as lying on a bed attended by three figures, one of which is fanning her. Below her bed is a water-pot. Bahurūpiṇī is represented in a recumbent position in some other sculptures as well.¹ (Pl. VA.)

21. Neminātha with a blue lotus (*nīlotpala*). Chāmuṇḍā is three-headed and four-armed with water-pot and *tridaṇḍī* in her left hands and in her upper right a rosary, the lower right being *varada*. With her mount swan and attributes and multiple heads she has affinity with Brahmāṇī. Images of Pārvatī with identical objects in hands, but with the lion-mount, are not too rare among the early mediaeval sculptures of Bhubaneswar. (Pl. VA.)

22. Neminātha whose cognizance is a flower (or *chakra* ?) and not a conch as required in texts. The representation of Āmrā is the only one fully answering to the canonical description. Seated under a mango tree (*mahāmra-viṭapi-chchhāyam śritā*), the two-armed figure holds in her left hand a branch of mango tree with a child in her left arm-pit and a fruit in her right hand. The mount is a lion. (Pl. VA.)

On the right wall are represented two *tīrthaṅkaras* with their *śāsanadevīs*. Beyond them is a nude standing figure with a water-pot near its feet. (Pl. VB.)

¹ See my article, 'Iconographic Notes', to be published in the *Journal of the Asiatic Society*.

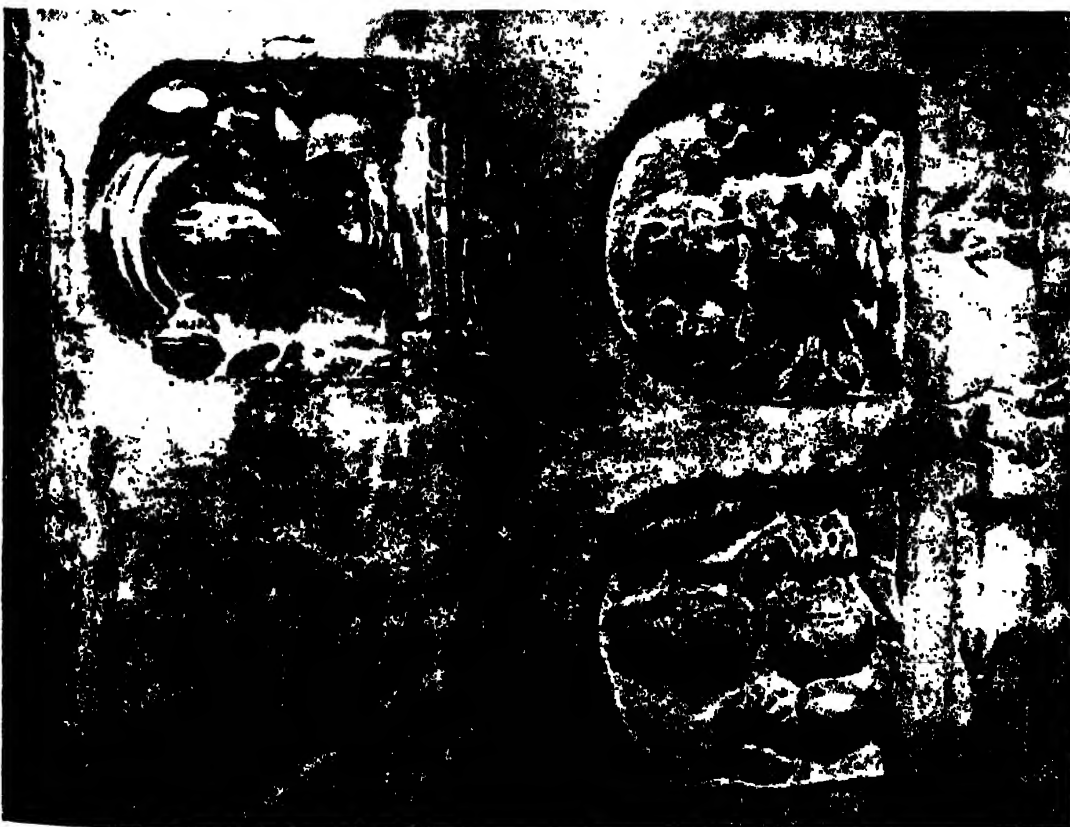
23. Pārsvanātha seated under a seven-hooded canopy with a three-hooded *nāga* figure beneath the lotus-seat. Padmāvatī, the *śāsana-devī*, is seated on a lotus under a five-hooded canopy. She is eight-armed having in her right hands the *vara*, an arrow, sword and disc (?) and in her left hands a bow, shield and stalks of lotuses. (Pl. VB.)

24. Mahāvīra with a lion. The twenty-armed Siddhāyikā holds in her right hands the *vara*, a spear, rosary, arrow, small staff (?), hammer, *hala*, *vajra*, disc and sword. Of the attributes in her left hands a water-pot, book, *mātulaṅga* (?), lotus, bell (?), bow, *nāgapāśa* and shield are identifiable. (Pl. VB.)

On the left wall of the verandah is the twelve-armed Chakreśvarī wearing a *dhotī* held by a girdle, bracelets, armlets, a *hāra*, *upavīta*, anklets, *kundalas* and a *mukuta* and seated in *lalitāsana* on a double-petalled lotus, below which are a Garuḍa and a devotee with a water-pot in between. One of her right hands is in *varada*, the second holds a sword and the third a disc. Of her left hands, one is held against her chest and three carry a shield, *ghaṇṭā* (?) and disc. Rest of the attributes are damaged. The relief was originally painted; traces of black lines on a darkish red background are discernible at places. Above her head is her *jina* Rishabhanātha with a bull below. (Pl. VIA.)

On the right wall of the verandah is the twelve-armed Rohiṇī seated in the same pose as Chakreśvarī, with her bull below. Among the attributes, the *vara*, a banner, *aṅkuśa* and disc in right hands and a *saṅkha* (?), water-pot, twig or *tridaṇḍī* and disc in left are recognizable. Above her head is her *jina*, Ajitanātha, with an elephant. (Pl. VIB.)¹

¹ The photographs published here are the copyright of the Department of Archaeology, Government of India.



A. Navamuni-gumphā : Gaucēa, Ṛishabhanātha and Chakreśvari



B. Navamuni-gumphā : Ajitanātha and Rohini : Sambhavanātha
and Prajñapti



A. Navamuni-gumpha: Abhinandana and Vajrasriṅkhala;
Vasumitra and Vasuṇḍara.



B. Navamuni-gumpha: Pārsyanātha and Padmāvatī;
Neminātha and Vasuṇḍara.



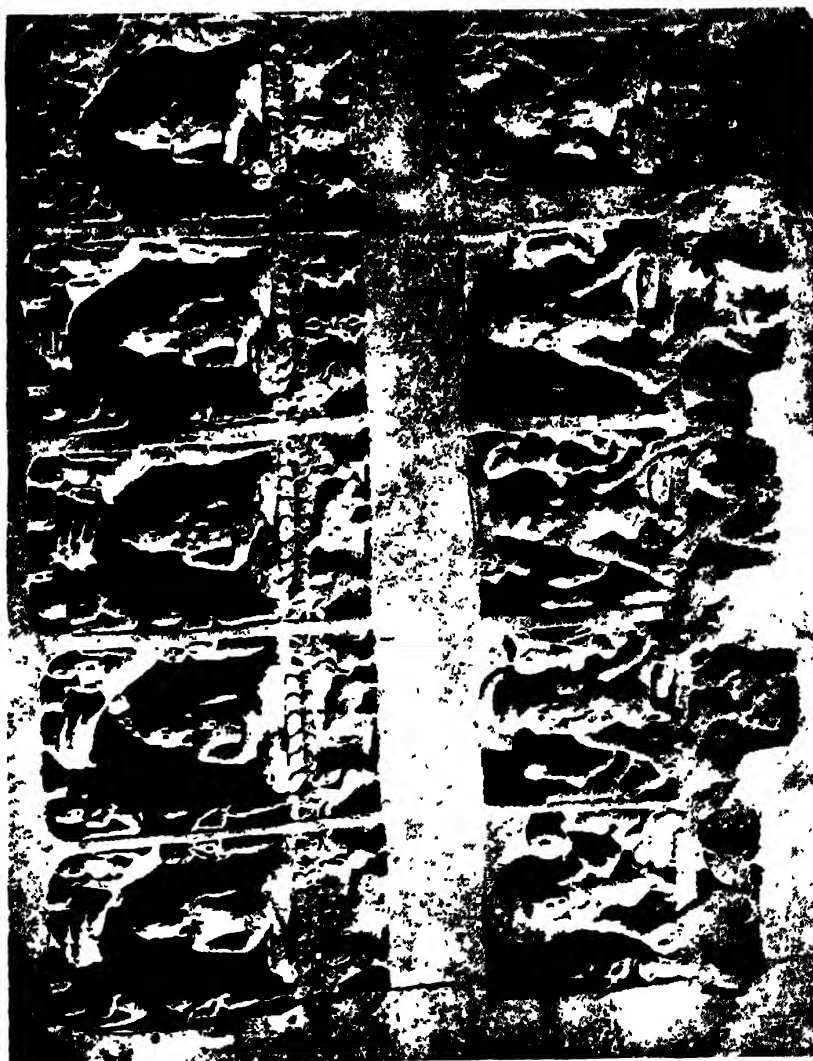
A. Bārabhuji-gumphā : first to fifth *tīrthaṅkaras* and their *śāsanadevīs*



B. Bārabhuji-gumphā : Pārśvanātha : sixth to eighth *tīrthaṅkaras* and their *śāsanadevīs*



A. Bārabhuji-gumphā : ninth to eleventh *virbhāikaras* and their



B. Bārabhuji-gumphā : twelfth to sixteenth *virbhāikaras* and their *sāsana*devīs



B. Bārabhuji-gumphā : twentythird and twentyfourth
tīrthāṅkaras and their *sāsanadevīs*



. Bārabhuji-gumphā : seventeenth to twentysecond *tīrthāṅkaras* and their *sāsanadevīs*



B. Bārabhuji-gumphā : Rohinī



A. Bārabhuji-gumphā : Chakreśvarī

FOUR ROCK INSCRIPTIONS OF BATAVIA

By HIMANSU BHUSAN SARKAR

The earliest inscriptions of Java belong to the western part of the island. They have been discovered in the hilly country round Buitenzorg and in the east of Tanjong Priok, the port of Batavia. All these inscriptions, four in number, are incised on rocks within the boundaries of the residency of Batavia and are not far removed from the seat of the government. Two other inscriptions in highly flourished script have indeed been discovered at Muara ciantën and Pasir awi,¹ but they have baffled all attempts for decipherment. We have, therefore, to rest content, for the time being, with the four rock inscriptions mentioned above.

These four rock inscriptions have been discovered from Ci-arutön, Jambu, Këbon Kopi and Tugu.² An outstanding contribution to the discussion of these inscriptions has been made by Prof. Vogel³ in his paper entitled 'The Earliest Sanskrit Inscriptions of Java'. This article has been accompanied by excellent facsimiles, but unfortunately the Dutch work in which this article was published is not easily available in India.

Three of these inscriptions have mentioned king Pūrṇavarman by name. The fair uniformity of the script and circumscribed *locale* of his records indicate—until other inscriptions are discovered in remote areas—that he was the ruler of a modest kingdom.⁴ Inscriptions do not throw sufficient light on the genealogy of the king. Only the Tugu inscription in ll. 1 and 5 refers to *rājādhirāja guru* and *pitāmaha rājarsi* who may possibly be the father and the grandfather of king Pūrṇavarman. Regarding Pūrṇavarman, however, this much is certain that he had his capital at Tārūmā (or, Tārūm), he had a fairly long reign and that Indo-Aryan culture was not unknown in his kingdom. It is not possible to determine, however, if he was an Indian emigrant or a Javanese prince who had adopted Aryan name and culture. The records do not also clearly indicate the religion of Pūrṇavarman, though it is probable that he was a Brāhmaṇical prince.

The scripts of these documents have similarity with Pallava-Grantha characters of the archaic variety. A comparison of these inscriptions with those of Borneo and Southern India reveals the fact that these records of Western Java have probably to be placed c. A.D. 450,⁵ though we must remember that there was not much change in Pallava-Grantha characters between A.D. 400 and 750. But how are we going to fix the sequence of these undated documents? Of the four inscriptions, only the Tugu record proves that Pūrṇavarman was living when that edict was promulgated: other records neither prove nor disprove anything. We have, therefore, to fall back upon the scripts to tell their tale. Among the four records under

¹ Vogel, *Publ. Oudh. Dienst*, I (1925), Pls. 34-35.

² For earlier literature on the subject, see VBG, XXXIII, p. 65ff.; BKI, 3: X (1875), p. 163ff.; IA, IV (1875), p. 355ff.; *Versl. en Meded. Kon. A.K. V. Wet. Afd. Lett.* 2: VI (1877), p. 255ff.; BKI 4: X (1885), p. 522ff.

³ *Publ. Oudh. Dienst*, I (1925), pp. 15-35.

⁴ Mr. Pleyte conjectured that his territories must have comprised the plains watered by the Ci-liwong and the Ci-tarum rivers.

⁵ cf. Vogel, *op. cit.*, p. 34; Kern, *VG*, VII, pp. 9, 131. Bühler seems to favour a much later date for the Jambu inscription. See his *Indian Palaeography*, p. 70.

review, the oldest character seems to have been used in the Ci-arutön inscription. With it, fair similarity of script has been maintained by the Tugu inscription, which has the additional advantage of being dated in the twenty-second year of the reign of the king. The Këbon Kopi and the Jambu inscriptions, on the other hand, betray a somewhat later development of the script, as we find herein vowel strokes developed into elegant ornamental curves. It is also possible that this variation is mainly due to the decorative style of writing of the copyists employed.¹ As this chronological knot cannot be disentangled with the aid of palaeography, we have no other recourse than to investigate the internal evidence of these two documents. The Jambu inscription shows that it was composed after the death of the king; the inscription of Këbon Kopi yields no promising data on this point. We have therefore to hold tentatively that the inscription of Këbon Kopi was engraved before the posthumous Jambu inscription. This arrangement has been maintained in the following description of these inscriptions.

(a) THE CI-ARUTÖN ROCK INSCRIPTION

This rock inscription is incised on a boulder lying in the bed of the torrent Ci-arutön² in close proximity to the spot where it joins the Ci-sadane. It was previously described as the Campea inscription, because the place where it was found belongs to an estate of that name. The alphabets have similarity with the box-headed Pallava-Grantha characters and the record has been written in more or less grammatically correct Sanskrit. The inscription proper does not, therefore, offer any difficulty, but great uncertainty prevails regarding the significance of the so-called 'spiders'³ attached to the footprints of the king and the decipherment of a line of cursive writing which is written over the inscription in a different direction to the right side of the royal footprints. Prof. Kern is said to have read the line as *Pūrṇavarmma padam*,⁴ but a glance at the inscription will suffice to show that the reading is extremely doubtful. Dr. Brandes is also reported to have deciphered the line as *Śri ci aru () eun vaśa* which he translates : 'the blessed lord of the Ci-arū () eun.' Though the addition of a *t* in the fifth syllable supplies us with the name of the river, the facsimile shows that the reading of Brandes is also equally impossible. Dr. Vogel remarks quite humorously : 'It is somewhat disconcerting that the two readings do not agree even in a single *akṣara*.' But he admits that the first letter is *śri*. According to him, the next *akṣara* seems to be *ā* and the fifth one *rya* or *rtha*. The reading of these two letters may very well be doubted. I think it to be certain, however, that the last letter is also *śri*. This cursive line of inscription may be written from right to left⁵ and read as : *śri cirutru desa* (or, *deśa*) *śri* (or, *śrī*). This means : 'the prosperity of the tract of the auspicious Cirutru'. It may also be read from left to right in which case the meaning of the line will be 'prosperity of the auspicious tract of Cirutru'. The forms of *ca* and *ta*, if they are indeed so, are somewhat archaic and, coupled with the

¹ cf. Vogel, *op. cit.*, pp. 34-35.

² Vulgo: Ciaruten or Ciaruteun.

³ For various theories, see Vogel, *op. cit.*, p. 23 and reference thereon.

⁴ *Notulen*, XLVII, p. 187, f.n.; Kern, *VG*, VII, p. 4, f.n. 1. Jayaswal's reading of this line (*EI*, XXII, pp. 4-5) as *śrī pūrṇavarmmanah* also appears to be extremely conjectural.

⁵ This form of writing is rare in India and only a few illustrations can be cited from earlier times. See Bühler, *Indian Palaeography*, pp. 3-4 of *Introd.*, and p. 8 of the text.

ornamental curves, these would imply a local development of the older Indian script in the island. It appears to me, however, that this line of cursive writing may have no connexion with the Ci-arutön inscription of Pūrṇavarman and may be a little older than that. This hypothesis is, of course, provisional, as the reading is not certain.

The spot where this boulder has been discovered is supposed by Prof. Vogel¹ to be the cremation-ground of king Pūrṇavarman on account of the curious position of the inscribed rock on the bed of the Ci-arutön torrent. There might be, however, other circumstances for the inscription being incised there, whereof we are quite in the dark.

The inscription is written in the *śloka*-metre, in four lines of Sanskrit verses, measuring 48 to 49 cm. Excellent facsimiles of this inscription have been published by Dr. Vogel² and the following transcription is based on them.

Text

1. Vikkrāntasyāvanipateh
2. Śrīmataḥ Pūrṇavarmmaṇaḥ³
3. Tārūmanagarendrasya
4. Viṣṇoriva padadvayam ||⁴

Translation

1. Of the mighty⁵ ruler of the world
2. the illustrious Pūrṇavarmman
3. (who is) lord of the town of Tārūma⁶
4. (this) pair of footprints comparable to Viṣṇu's |

(b) THE TUGU ROCK INSCRIPTION

This rock inscription was found at the village of Tugu which is situated to the east of Tanjong Priok, the port of Batavia. As this village is comprised within the district of Bēkasiḥ, this inscription is sometimes described as the Bēkasiḥ inscription. In the year 1911, it was removed to the Batavia Museum where it has been deposited in the epigraphical section as D. 124.⁷

¹ *Op. cit.*, p. 20.

² *Op. cit.*, pls. 28-29.

³ Vogel's reading of 'varma' is not correct and this is probably due to an oversight.

⁴ The use of the words *Vikrānta* and *Viṣṇoriva padadvayam* jointly suggests Tri-vikrama—incarnation of Viṣṇu.

⁵ *Vikrānta* (= Vi + kram + kta) may also possibly mean 'deceased'. My colleague, Prof. S. K. Bhattacharya, endorses this interpretation. If this interpretation be accepted, king Pūrṇavarman would appear to have been deified and his feet were adored like those of Viṣṇu's. This interpretation will bring the idea in line with Vogel's suggestion referred to in a preceding paragraph mentioning that the find-spot is the cremation-ground of king Pūrṇavarman. So far as I can see, one difficulty in accepting this interpretation from palaeographic point of view is that this inscription seems to be the oldest of Pūrṇavarman's inscriptions. Against it, it can be urged that palaeographic evidence cannot, by itself, be infallible.

⁶ Mr. Pleyte (*Het Daghet*, I, p. 178) has made the ingenious suggestion that the name Tārūma is perhaps preserved in the river Ci-tarum which indicates the boundary of the (old) residences of Batavia and Krawang, to the east of Buitenzorg. The meaning of the name of *Tarum* is 'indigo' in Indonesian vocabulary.

⁷ For previous readings and discussions see *BKI*, 4: X (1885), p. 522ff.; *TBG*, LII (1910), p. 123; *VG*, VII, p. 129ff., with a facsimile of a part of the inscription.

The last scholarly edition of this inscription has been made by Prof. Vogel,¹ whose reading is based on a set of excellent squeezes.

The stone on which the inscription has been incised is conical in shape and the first three lines of writing run through it in a curve. The last two lines are more or less straight. In this inscription with lines of unequal length, double vertical strokes have been used to denote the lines of separation. The script is clearly engraved on the otherwise excellently preserved inscription. Before the opening line of the record, there is a carving of unknown significance : it looks like a trident or a burning torch.²

The language of the inscription is slightly obscure in one or two places and there have been some grammatical mistakes. It is written in five stanzas of Sanskrit verses, couched in *śloka*-metre. The transcription given below is based upon the facsimile published by Vogel.³

Text

1. purā rājādhirājena guruṇā⁴ pīnabāhunā khātā khyātām purīm prāpya
2. candrabhāgārṇavam yayau || pravarddhamānadvāviṇśadvatsara⁵ śrī-
gūṇaujasā narendradhvajabhūtena⁶
3. śrīmatā pūrṇavarmmaṇā || prārabhya phālgūṇa⁷ māse khātā kṛṣṇāṣṭa-
mīthau⁸ caitraśuklatrayodaśyām⁹ dinais siddhaikaviṇśakai(h)
4. āyatā ṣaṭsahasreṇa dhanuṣā(m)sa-satena ca dvāviṇśena nadī ramyā
gomatī nirmalodakā || pitāmahasya rājarṣervvidārya¹⁰ śībirāvanim¹¹
5. brāhmaṇairggosahasrenā¹² prayāti kṛtadakṣiṇā ||¹³

Translation

1. Formerly, the Candrabhāgā, dug by the overlord of kings (viz.) the strong-armed *guru*,¹⁴ having reached the famous town
2. went to the ocean. In the twenty-second year of his augmenting reign, by the illustrious Pūrṇavarmman, who became the foremost (lit. banner) of the rulers of men on account of¹⁵ the lustre of auspicious qualities,

¹ *Op. cit.*, p. 28ff.

² To Dr. Vogel it appears like a trident (*triśūla*) with some floral or foliated ornament. Dr. Rouffaer (*Notulen*, XLVII, p. 186, f.n.) describes it as a 'sacerdotal staff crowned with a trident, the central prong of which has the shape of a lotus-flower'.

³ *Op. cit.*, pl. 27.

⁴ Vogel reads °nā, but °nā is certain.

⁵ Read, °are.

⁶ Vogel reads °bhūnena and corrects it as above. *Te* is, however, certain. In this inscription, *ta* is distinguished from *na* by the slightly triangular form it (*ta*) betrays.

⁷ Read, °une.

⁸ Vogel's reading is *kṛṣṇāṣṭamī*°, which appears to be an error in printing.

⁹ Or, *ce*°. In that case read: *cai*.

¹⁰ Vogel misreads it as °rya.

¹¹ Vogel reads *śi*°, but the sign of the longer medial is present within the loop. The word should be corrected as *śivirā*°.

¹² Read, °na.

¹³ °nā is not certain. It may also doubtfully be read as °no.

¹⁴ This may also be translated as: 'overlord of kings (viz.) Pīnabāhu, the guru . . .' Here Pīnabāhu may be a proper name, and *guru* may stand for 'father'. But if *guru* has a different significance here, it cannot be ascertained whether *rājādhirāja guru* (l. 1) and *pitāmaha rājarṣi* (l. 4) should refer to one and the same person or to different persons.

¹⁵ My translation slightly differs from that of previous writers on account of my considering the phrase to be a case of *hetvārthe tṛityā*.

- 3.4. was dug the charming river Gomatī,¹ of pure water, in length six thousand one hundred and twenty-two *dhanus*,² having begun it on the eighth day of the dark half of the month of Phālguna and completed it in twenty-one days, on the thirteenth day of the bright half of (the month of) Caitra.³ (That river) by digging through the camping-ground of the grandfather and royal sage
5. floweth forth after having been endowed by the Brāhmaṇas with the gift of a thousand cows.

(c) THE KĒBON KOPI ROCK INSCRIPTION

This inscription is incised on a rock which is found in a plateau enclosed between the two rivers of Ci-sadane and Ci-arutön. This inscription has sometimes been called the Campea inscription, but as this name has also been applied to the Ci-arutön inscription, it is better to avoid the title of Campea inscription altogether. In the immediate neighbourhood of this Kēbon Kopi inscription, Rev. Brumund long ago noticed limestone pillar bases, 1½ feet in each dimension, some of which were preserved *in toto*.

The stone inscription was included in the *Report* of Hoepermans, but it was first brought to public notice in 1868 by Rev. Brumund⁴ who mentions two huge footprints of elephants carved on both sides of the inscription.⁵ The last scholarly contribution on this record comes from the pen of Prof. Vogel⁶ who has distinctly improved upon the reading of Dr. Kern. His article is accompanied by facsimiles.

Dr. Vogel⁷ observes that 'although the inscription was executed with evident care, several of the *akṣaras* are more or less damaged or have become completely obliterated. It is especially the central portion of the inscription which has suffered . . .' The inscription betrays decorative style of writing which it shares with the Jambu inscription.

The inscription does not refer to the name of any king, but mentions one Tārume(ndra), who, if we may rely on palaeographical evidence, is probably no other than king Pūrṇavarman. Palaeographical evidence is by no means exact and it may turn out after all that the inscription refers to a successor of Pūrṇavarman. Till evidence comes to the contrary, we shall regard this Tārume(ndra), for all practical purposes, to be the same person as king Pūrṇavarman.

The inscription is written in Sanskrit verses and the metre is *śloka*.

Text

—Jayaviśālasya tārume(ndra)sya ha(st)inah
—(airā)vatābhasya vibhātīdampadadvayam(|||)

¹ A river of this name is mentioned in the *R̥gveda* (X. 75. 6). The river Gomatī is also known to flow by Lucknow. Another river of this name exists in Tipperah, Bengal. The names of Candrabhāgā and Gomatī are indeed found in lists of South Indian rivers as given in the *Purāṇas*, but these lists are not reliable in all cases. Channels of these names are also found in the Ceylonese chronicles (*Mahāvamsā*, LXXIX, 49, 53; *Cullavamsā*, LXXIX, 48, 52).

² 1 *dhanu* = 4 *hastas* = 2 yds. The canal was, therefore, approximately seven English miles in length. According to another reckoning, twelve miles.

³ In these references, Dr. Vogel (*op. cit.*, p. 32) sees the currency of amānta-scheme and considers this to be a case of South Indian influence.

⁴ VBG, XXXIII, p. 64.

⁵ For earlier literature, see BKL, 4 : X (1885), p. 525; TBG, LII (1910), p. 124; VG, VII, pp. 135-6, with facsimile.

⁶ *Op. cit.*, p. 27ff.

⁷ *Ibid.*

Translation

(Here) shineth the pair of footprints of the . . . Airāvata-like elephant¹ of the lord of Tārūma (who is)² great in conquering . . .

(d) THE JAMBU ROCK INSCRIPTION

The rock inscription of Jambu lies on the top of a hillock called Pasir Koleangkak, which is 21 *paal* west of Buitenzorg. The record has derived its name from the Jambu estate which belongs to the same district as the Ci-arutōn inscription. After its discovery in 1854 by Mr. Jonathan Rigg, it was successively described by Friederich,³ Hoepermans⁴ and Rev. Brumund.⁵ Kern, who made the first serious attempt to decipher the script, contributed some articles between 1875 and 1910.⁶ Dr. Vogel⁷ has further suggested some improvements upon the last reading adopted by Kern.

About the general appearance of the document, Prof. Vogel⁸ states that the inscription is cut in elegant characters on the flat surface of the rock and consists of two lines . . . Here, too, a pair of footprints are carved over the inscription, but they are partly broken off with the top of the rock . . .

The inscription consists of only one stanza of Sanskrit verses written in *śragdharā*-metre. Each line consists of two *pādas* and there is no serious grammatical mistake. The record was evidently incised after the death of the king who has been represented here as a great military hero. This eulogistic reference was made in connexion with the engraving of a pair of footprints of the king.

In the following transcription I have relied upon the facsimiles published by Prof. Vogel.⁹

Text

1. Śrīmān = dātā¹⁰ kṛtajño narapatir = asamo yaḥ¹¹ purā Tār(u)māyām¹²
nāmnā śrī pūrṇavarmmaḥ pracuraripuśarābhedyavikhyātavarmmo¹³
2. tasyedam = pādavimbadvayam = arinagarotsādane¹⁴ nityadakṣam
bhaktānām yandripānām¹⁵ = bhavati sukhakaram śalyabhūtam
ripūnām.

¹ In Indian mythology, Airāvata is known as the *vāhana* of Indra, the king of gods.

² Or 'was'. ³ *TBG*, III (1855), p. 183ff.

⁴ 'Hindoe-oudheden van Java (1864)' in *Rapp. Oudheidk. Dienst*, 1913, p. 75ff.

⁵ *VBG*, XXXIII (1868), p. 65ff.

⁶ See *BKI*, 3 : X (1875), p. 163ff.; Kern, *VG*, VII, p. 4, f.n., with facsimile; *Versl. Meded. Kon. Ak. v. Wet. Afd. Lett.*, 2 : VI (1877), p. 257ff. The paper was read at Amsterdam on Nov. 13, 1876; *TBG*, LII (1910), p. 123ff.; Kern, *VG*, VII, p. 1ff., with facsimile.

⁷ *Op. cit.*, p. 24ff.

⁸ *Ibid.*, p. 25.

⁹ *Op. cit.*, pls. 30-31.

¹⁰ Kern read *pā°*. The *dā°* is clear on the plate, though in the photo of Kinsbergen (No. 12) it appears like *pā°*.

¹¹ Read, *yo*.

¹² Vogel's reading of °*māya(m)* is certainly incorrect, as the sign for the medial *ā* is extremely clear on the plates. The *anusvāra* need not be placed within brackets, as this is visible to the right above the *serif*.

¹³ Read, °*mā*.

¹⁴ Mr. Pleyte (*Het Daghet*, I, p. 178) and Dr. Rouffaer (*Notulen*, XLVII, p. 152, f.n.) are certainly mistaken in discovering the name of the river Ci-sadane in the Skt. word *utsādane*, which forms the third member of the compound above. The suggestion has nothing to commend itself.

¹⁵ Read, *yannrpā°*. Kern's final reading of *tridhatau* appears to be wrong, while Vogel's reading tallies with ours.

Translation

1. Illustrious, munificent, grateful¹ was the unequalled lord of men, the illustrious Pūrṇavarmman by name,² who once (ruled) at Tārumā and whose famous armour was impenetrable to the arrows of a multitude of enemies.
2. Of him, this is the representation³ of the pair of footprints which, ever dexterous in demolishing towns of enemies, is salutary to devoted princes (but) like darts to (his) enemies.⁴

¹ Vogel translates *kṛtajño* by 'true to his duty'. As there might be circumstances for which the king could be grateful, I translate the above word according to its established usage in Skt. literature. Vogel's interpretation of the term is also possible, though we must admit that the use of the word in this sense is rather unusual. Besides, there are many other less ambiguous words in Skt. which could have been profitably used in Vogel's sense.

² The writer makes a pun with the word *varmmā*.

³ Vogel has left this out in his translation.

⁴ This statement may offer a solution to the problems of the so-called 'spiders' in the Ci-arutōn inscription. These 'spiders' appear to be no other than the enemies of the king.

THE 'PATTAMADAI KORAI-MAT' INDUSTRY

By K. S. SRINIVASAN

The term 'straw' is commonly applied to the dried culms or stems and stalks of certain sedges and grasses. The very early use of straw in the remote past must probably have been as bedding or floor-cover for primitive mankind or as food and fodder for the cattle. As civilization progressed, additional uses were possibly found for these materials as thatching for primitive shelters and body coverings. In the present day, however, straw is one of the basic raw-materials of many industries such as stuffing of beddings, weaving of hats, plaits and baskets, making of ropes, preparing of pulp for paper and straw-boards and as packing materials during transit of fragile articles. Mat-making would also perhaps rank important, as it is well known for years that 'many of the Indian grass-mats are admirable examples of elegant design and the colours in which they are woven are rich, harmonious and effective in the highest degree'.

Indian sedge and grass-mats are of very great antiquity. From very ancient times, sedges and grasses are known to have been used in India in the preparation of mats. Evidences of use of grass-mats are available in the ancient classical literature and early sculptures of the second century B.C. and first and third centuries A.D. even though how and when mankind first became aware of the possibilities of these vegetable products as materials for an industry it is not easy to say.

According to the classical writers, the Indian hermits used mats made of *Kusa* and *Darbha* grass. The *Kusa-asana*, a seat-mattress of *Kusa* grass, has all along been considered as the most holy *asanas* used by Rishis and Brahmins. In Ancient India, it was this *Kusa-asana* which was offered to all sacred persons as Rishis and Brahmins, even when they came to royal palaces. The kings of the *Ikshvaku Family* renounced the world in their old age, and Raghu in such a state is described as seated on a holy and pure *Kusa* mattress.

‘परिचेतुमुपांशु धारणां कुशपूतं प्रवयास्तु विष्टरम्’

[*Raghu* : VIII, 18]

In the drama of *Dattavallya* of Bhasa, the seat offered for Drona in Duryodhana's palace is of *Kusa*.

‘एतत्कुशासनं आस्यताम्’

Even kings and monarchs, while observing temporary religious life, like Dilipa, who attended to the cow of the sage Vasishta with devotion, were offered *Kusa* mats for bedding, though costlier materials could easily have been provided.

‘संविष्टः कुशशयने निशां निनाय’

[*Raghu* : I, 95]

In *Rāmāyaṇa*, there is reference to Rama pulling out a *Darbha* from his *Darbhasana* to use his *Brahmastra* against the crow.

‘ स दर्भं संस्तराद् गृह्य ब्राह्मेणास्त्रेण योजयत् ’

[*Rāmāyaṇa* : V, xxxviii]

The *Darbhasayana* of Rama with all devotion and holiness at the shore of the ocean is too well known to need repetition. The *Darbha* is so holy that in doing any sacred ceremony even today it is placed as a seat.

‘ दर्भेष्वसीनः ’

In the famous Barabudur sculptures, we have a scene of the *Bodisattava* on the way to *Bodhimanda*, receiving grass from the grass-cutter *Swastika*, on having remembered that the former ‘infallible ones’ who attained the highest and most perfect wisdom sat themselves on grass that was spread (Fig. 1). In the *Nāgārjunakoṇḍa* sculptures (third century A.D.), there are beautiful bass-reliefs of the ruined stupas illustrating the well-known stories from the *Jatakas* or incidents in the life of Buddha, wherein also mats, mattresses and coverlets are represented in some of the scenes.

Several species of grasses and sedges have been known in use for years in the past in the manufacture of mats in India. The straw of the common paddy-plant *Oryza sativa* Linn. is used in Hazra and other places for mats called *Mandri* and *Phindi*. Mats of *Munj* grass, *Saccharum munja* Roxb. (*Saccharum sara* Roxb.; *Saccharum ciliare* Anders.), have been known from Allahabad, Agra, Ambala, Banaras, Delhi, Gujerat, Ludhiana, Lucknow, Monghyr and Sialkot. From *Eulaliopsis binata* (Retz.) C. E. Hubbard (*Ischaemum angustifolium* Hack.), the *Bhabar* mats of N.W. Provinces are made, and from *Phragmites roxburghii* Trim. the *Dharma* mats of Bengal are prepared. The roots of *Vetiveria zizanioides* Nash. (*Andropogon muricatus* Retz.) provide the raw-materials for the *Khas-Khas* mats. Among the sedges and allied species *Scirpus littoralis* Schrad. (*Malacochaete pectinatus* Nees.) is used in Kashmir for mats. *Cyperus esculentus* Linn., forma *tuberosa* (?), *Cyperus esculentus* Linn., forma *hindustanica* (?), *Cyperus exaltata* Retz., *Cyperus iria* Linn., *Cyperus tegetum* Roxb. (*Cyperus pongareii* Rottb.) and *Cyperus corymbosus* Rottb. are the most important species in India used for mat-making. The well-known *Madur* mats of Bengal and the best sorts of *Masland* mats are prepared out of the culms of *Cyperus tegetum* Roxb. In South India, *Cyperus corymbosus* Rottb. (Fig. 17) is the most favourite species used for quality mats. Although sedge-mats are known to be manufactured in several places in South India as in the districts of Godaveri, Krishna, and Nellore in Andhra Pradesh, Chingleput (Wandiwash), North Arcot, Salem, Trichinopoly, Tanjore, Madura and Tirunelveli in Madras State, S. Kanara in Mysore State, and Malabar (Palghat) and Cochin and Travancore in Kerala State, there is perhaps no parallel to the superfine quality mats of Pattamadai in Tirunelveli District, which products are celebrated and held in great esteem in our country and even abroad.

In this paper a detailed account of the Pattamadai sedge-mat industry is given, based on a survey and first-hand study made by the author at the industrial centres in Pattamadai and the neighbouring villages in the Tirunelveli District. Some information, hitherto not available in any of the earlier published accounts on this cottage industry, is also added which, it is hoped, will be found interesting.

Pattamadai is a small village in the Ambasamudram Taluk in Tirunelveli District in South India. The District itself is about 11,205 sq. km.

(4,326 sq. miles) in extent and is situated east of Gulf of Manaar and west of Travancore. The chief river of the District is *Tambarabarani*. This river is about 120.7 km. (75 miles) long from its source to the Gulf of Manaar. The sedge *Cyperus corymbosus* Rottb., locally called *Korai*, which forms the basic raw-material of the mat industry, grows in almost all the Taluks in the District. But the *Korai* growing in the Taluks of Nanguneri, Ambasamudram, Tirunelveli, and Tenkasi alone are chiefly employed for mat-weaving. This sedge is not grown in the Koilpatty Taluk, although *Korai*-mat industry is to be seen at Kayathar in that Taluk, entirely based on imported raw-materials from other localities in the District and elsewhere. The remaining three Taluks in the District, viz. Sankarankoil, Srivaikuntam and Tiruchendur, are comparatively of little importance so far as the *Korai*-mat industry is concerned.

The sedge growing on the banks of the river Tambarabarani, and on the small sandy-islets formed in various places in the river bed, along its course, is found to be the most suited for quality mats. The Pattamadai mat-weavers generally have their harvests of the sedge for fine and super-fine mats from a village called Melathiruvengadanathapuram, now called Tirunangkovil in the Tirunelveli Taluk. Here, as elsewhere, the sedge grows covering extensive tracts of fields and open lands. It is also seen to grow as tussocks on fine sand-bunds, sandy-islets and similar situations along the river banks and in the river course itself (Figs. 2, 3). Nearer Tirunangkovil, the sedge grows abundantly from Karungadu to Sayani for over two miles along the course of the river, and this crop is also harvested by the Pattamadai mat-weavers.

In the entire District, the sedge is harvested principally for mats from nearly over 75 villages spread over the four Taluks of Nanguneri, Ambasamudram, Tenkasi and Tirunelveli. In some cases, the Government have leased out some acres of lands with sedges to recognized Weavers' Associations and other individuals. In 1952, 116.15 acres were thus leased out in Nanguneri Taluk, 181.20 acres in Ambasamudram Taluk, 45 acres in Tenkasi Taluk and 140 acres in Tirunelveli Taluk. Out of the 140 acres leased out in Tirunelveli Taluk, over 120 acres were given free to Pattamadai Weavers' Association. Similarly, in Nanguneri Taluk, the Giriammalpuram Mat-Weavers' Production Association were given concession for removal free of charge *Korai* in all the unassessed lands in that Taluk till 30.6.1954 with extensions of lease-term periods. Also about 69.87 acres were given to the same Association in Ambasamudram Taluk from the 181.20 acres leased out in that Taluk. Such of the Associations or Weavers who do not possess any field, or who do not enjoy such concessions, have to purchase the *Korai* from the various local markets at Pettai, Harikesanallur, Veeravanallur, Mudaliarpatty, Kayathar, Veerakeralampudur, Veerannam, Pattamadai and a few other places. In 1952, Kayathar alone imported about 10,000 maunds of *Korai* from other Taluks in the District, for the rough quality mats woven at that centre.

During the Tamil months *Chittirai* and *Vaikasi*, corresponding to April and May, the leased out fields are left open for cattle to graze and feed on the sedges and grasses in the fields. But for the remaining ten months of the year from *Ani* to *Panguni* (i.e. June-July to February-March) watchmen are provided and the fields are guarded. During this period, the sedges grow freely and luxuriantly quite uninterfered with. By about *Purattasi* (October), the sedges become ready for a first harvest, and again on further fresh growth by *Masi* or *Panguni* (February-March), the fields are ready for a second harvest. Thus in a year two harvests are

made, one in *Purattasi* (October) and the other in *Masi* (February) or immediately after.

Harvesting is done by employing the class of people known as *Pallars* (Fig. 4). Occasionally, however, Muslims are also employed. For the sake of economy, only women are generally employed for cutting the sedges from the fields. The harvest is done by women of all ages, and usually above 12 years of age. Sedge-harvesting is only a side occupation for these class of labourers, as they have other occupations in agriculture or as daily-wage earners.

The implement used for cutting and reaping is a simple form of scythe (Fig. 16). While cutting the sedges, about 4" of the stump at the base above the ground is left out, and the rest is cut. The average wage for cutting is 3 annas per bundle of fresh sedge, the size of which is determined as that quantity of fresh sedge which when dried up could be held between the distended two middle fingers and the thumbs of the two hands with their tips just in contact to form one handful of dried sedge. Roughly, the size of the dried bundle comes to about 17" in circumference at about 20" from the base of the bundle.

As soon as the sedges are harvested, they are immediately brought on to the bank of the river or to any convenient nearby place of the field from where harvested. The tips and flower-tops, if any, of the fresh sedges are then cut away and discarded. The discarded portions are used by the *Pallars* as fuel when dried. The trimmed sedges are then sorted out into different lengths (Figs. 5-7). This is done by a very simple method.

Small lots of the cut sedges are taken at random, and a handful of such sedges is then struck gently on the ground, keeping the lot rather loosely held, till the bases of all cut stumps get to the same plane and level. Then with the right hand, the bundle is held tight a little below the top, and the whole lot raised from the ground and gently shaken, thereby allowing the smaller sedges not in the grip to fall down. By repeating this process several times with the entire lot of harvested sedges, they are ultimately sorted out into four kinds, each kind being of specific length. The four standard sizes of trimmed sedges are recognized by the commercial terms—

<i>Marmattam</i> ..	(Length of culms, 42" to 44")
<i>Attalavu</i> ..	(About 36")
<i>Mattalavu</i> ..	(32" to 33")
<i>Kattai</i> ..	(30" to 10")

The assorted and trimmed sedges are then split lengthwise into two halves by a special knife, locally called *Korishaik-katthi* (Fig. 16). In this process, the sedge is pierced at its middle part one by one, by the pointed end of the knife, and when sufficient number of culms as can be conveniently held on the blade of the knife are thus pierced, the entire lot is split lengthwise, by one stroke of the knife towards the base of the culms from the pierced middle part and followed by a similar stroke in the opposite direction towards the tip. The Muslims, who are well trained in this, perform this operation with great efficiency and speed. Muslim women are also employed for splitting the sedges. The wages for splitting is generally in kind. That may either be half the quantity of the split sedges or half of the entire culms brought for splitting. The sedges which the labourers get against wages for splitting are either sold by them to other weavers, or used by themselves for making mats.

The split sedges are then sun-dried by spreading on floor or on open ground, and exposed to bright sunlight (Fig. 8). But during nights, they

are removed and kept inside huts or similar buildings. The sedges should not be exposed to humid conditions, as that would tend to blacken the sedges, and thus prevent the otherwise pleasing colour being obtained. The sun-drying is carried on for three or four days. The sedges by this time get more or less dried up, with the edges of the split-up strands getting slightly rolled up also. The colour, however, remains slightly greenish.

After three or four days' drying in the open sun, the sedges of each sort are made into very small bundles. Ten such small bundles are further made up to form one larger bundle, and the entire lot is made up of such larger bundles. Each large bundle comes to be of a size that could be held in between the two middle fingers and the two thumbs kept with their tips just in contact, and the fingers and thumbs themselves being held well distended. Such a bundle measures about 17" in circumference at its middle portion. These bundles are then removed to the weaving centre, which is usually the home or thatched hut of the individual weaver.

A portion of the dried sedges, in bundles, is also made available for sale for other weavers who have no fields. The prices of the sedges vary according to their sizes. The cost of 10 (ten) large bundles of each particular size is as indicated below as it stood in the year 1952.

<i>Marmattam</i>	(42" to 44")	..	Rs.25 to Rs.30
<i>Attalavu</i>	(36")	..	Rs.18 to Rs.22
<i>Mattalavu</i>	(32" to 33")	..	Rs.12 to Rs.15
<i>Kattai</i>	(30" to 10")	..	Rs.4 to Rs.6

The prices as above are understood to be three times the pre-war prices.

The split sedges which have been dried for three or four days are used straightway and woven into rough quality mats. According to the thickness of the split sedge, rough or coarse mats of 16 to 26 counts are woven. These mats when prepared are slightly greenish in colour. But in course of time, the colour of the mat gradually changes into yellow. For coarse variety mats, *Agave* fibres, commonly called *Kathazhai-nar*, are used for the warp and the split sedges are used for the weft. *Agave* fibre is used for coarse mats up to 26 counts only. The *Agave*-plant grows in all dry localities in the district, and in many places, they are grown also as small hedge-plants. For fibre, only the terminal young shoot is plucked from the plant, which, with the tightly held imbricate leaves, comes off as a small cone. With the help of a crude scraper the tender shoot is scraped and the fibre is extracted. The extracted fibres are partially dried and then spun into thin threads in an ordinary *Charka*. These fibre-threads are then used for the mat-weaving, the thickness of the threads being previously determined for the particular type of mat to be woven.

For finer and superior quality mats, the process is different and somewhat elaborate. The split sedges are dried in bright sun for over twenty to twenty-five days in the open, and removing them indoors at every night. This drying is done generally during the summer months of *Panguni* and *Chittirai* (March-April). The sedges turn completely yellow on such drying. Great care is taken to ward off moisture and its effect on the sedges during the period when they are dried thus.

When the sedges are completely dried, they are then retted in water, which is a most important stage in the industry. This is done with care and caution, as the quality of the superfine mats depends much on the successful retting. The dried sedges are made up into very small bundles, each of the large bundles mentioned earlier being split up into 80 smaller bundles. For tying them up, one of the strands of the split up sedge alone is used. To each large bundle stones of sufficient weight are weighted at

near both the ends of the bundle, the stones being tied also with the strands of the sedges. The bundles are then floated in gently flowing streams of clear water, the weight of the stones being so adjusted that the sedges remain more or less just below the surface level of the water and not too much immersed. The bundles are always kept floating in the same direction as that of the current in the stream. They are never kept across the current. Deep water places are not chosen, and for best retting, the sedges are kept in knee-deep to waist-deep of gently flowing clear water streams. Turbid and brackish waters are also never chosen for retting the sedges for superfine mats. For mats of 30 to 80 counts, the sedges are retted for three days. But for superior quality mats of 90 to 140 counts, they are retted for clear seven days. During the period of retting, the sedges are daily washed clean by gently rubbing them every day in the morning and evening. All the dirt and other foreign materials are thus washed away. While the sedges are thus kept soaked in running water, they swell up, and after seven days' soaking, the sedges swell up to nearly four times their original size. Sedges kept soaked in running water for retting for more than seven days become useless for mat-weavings.

The retting is generally done throughout the year. The river *Tambara-barani* and one of the canals in the district, the *Kannadian-canal*, are the best and most suited for retting sedges for fine and superfine mats. At Eral, and places nearer sea, the water in the rivers and streams becomes useless for retting purposes. The colour of the retted sedges also varies with the seasons, rainfall, and nature of water in which they are soaked. During rainy months, when the rivers and streams get muddy, the *Korai* get blackened on retting. Pure yellow colour is obtained only when the sedges are retted in dry summer months and in clear fresh water in slowly running streams and river tributaries. If in the course of seven days' retting rains were to occur, the sedges are immediately removed from the rivers and streams and the retting is not continued any further. Such sedges are dried and coloured with dyes and used in mats. But even with colouring, if they are found unsuitable, they are discarded.

While the three days' retting is more prevalent, and practised in many places in the district and outside, the seven days' retting is practised only at the village Pattamadaï by the weavers in that locality. Within the district, the three days' retting is done in Pattamadaï, Veeravanellur, Hari-kesanellur, Shermadevi, and several other villages through which the Kannadian-canal flows. The sedges retted for three days are used for preparing strands for mats of 30 to 80 counts. The inner core of pithy matter which by the retting gets into a sort of a pulpy matter is removed with a fine knife, and the pleasing yellow coloured outer rind of the sedge is then split into very fine strands (Fig. 8). For superfine mats of 90 to 140 counts, however, the sedges retted for seven days alone are used, and after removing the inner pulpy matter a very delicate and membranous layer just immediately below the epidermis is also removed and then the epidermis alone is split into very fine strands of thickness of about two hair-breadths or four or thicker as may be required (Fig. 9). Each fine strand has a sort of resilience, somewhat similar to that of a very fine rubber-band. Within twenty-four hours of splitting, the fine strands are ready for the loom to be woven into superior mats of different counts.

The finely split sedge strands are dyed with different colours, the more usual and standard colours being red or purple, green, orange and black. In recent years, chemical dyes manufactured chiefly by the Imperial Chemical Industries are used for these colours. But before the use of chemical dyes, purely vegetable dyes were used.

The dyeing process is very simple. In a large wide-mouthed, basin-like earthen vessel, water is boiled, and to this, the chemical-dye-powder is added and kept boiling for some time. The sedge strands in small lots are then steeped in this boiling mixture, and kept for about five minutes. After five minutes, the earthen vessel, with the hot dye solution and the sedges steeped in it, is removed from the oven, and their wide mouths are kept covered with earthen discs. After a few hours, and when the solution has cooled, the sedges are removed and they are then dried in shade, in an airy place. The sedges which are differently coloured are made into different bundles and stored in a dry place for weaving mats with them. The solution is used only once for dyeing and after the process of dyeing, it is never used again for dyeing fresh lots. The dyed strands are never exposed to sun for drying, as that would not yield best results.

This process is not followed now at all, as it has almost disappeared from practice with the introduction of aniline dyes.

The finely split sedge strands in their natural beautiful and pleasing yellow colour, as well as those differently coloured, red, orange, purple and black, are used in the loom as weft in the process of weaving mats of different patterns and qualities (Fig. 15). The loom is of simple construction (Figs. 10, 12). It consists of two cut bamboos each of a little over 4 feet long. These two cut bamboos are kept at a distance of 9 feet on the ground and tied on to iron-pegs, driven in the ground. The pegs may also be of wood. The two bamboos carry the longitudinal threads, the warp. Three other slender bamboos are tied up to form a sort of tripod stand to which are suspended the reed with other simple contrivances for preparing 'shed' while weaving. The bamboo may be replaced by wooden shafts or thin pillars also, and for this any sort of light wood is used. Occasionally teak (*Tectona grandis* Linn.) or any light country wood is also employed for this purpose. The plank, which forms the seat for the weaver, is of mango-wood, *Mangifera indica* Linn. The reed or *acchu* is made of *Mimusops hexandra* Roxb. (*Ulakka-ppalai*). In some cases, bamboo is also substituted for the reed. Iron is never used as this rusts and interferes with the quality of the fine and superfine mats. The shuttle to carry the weft is made of the wood of the trunk of *Caryota urens* Linn. (*Koonthal-panai*), which is most durable. Teak (*Tectona grandis* Linn.) is also used for the shuttle. The shuttle varies according to the size of the mat to be woven. It is of the nature of a gigantic needle, with one end gently tapered and narrowed. There is an eye at some distance behind the narrowed end for the weft to be inserted. The lengthwise threads in the loom—the warp—is cotton yarn of different counts, according to the counts of mats required to be woven. It is as follows:—

For 50 counts mats	..	20	counts	yarn	are	used.
For 50-80 counts mats	..	40	"	"	"	"
For 90-130 counts mats		80	"	"	"	"
For 140 counts mats	..	100	"	"	"	"

In all the above, four threads of yarn of particular count selected are twisted together in an ordinary *Charka*, to be made into *warp* for the loom. The cotton yarns for the mat-weaving are supplied by the Harvey Mills and Madura Mills, the 20 counts yarn alone being supplied from the Mills at Papanasam, while the higher counts being supplied from the Mills at Madura. As already mentioned, for coarse variety mats up to 26 counts *Agave-fibre* is used. The 'shedding' and 'beating up' processes are done by very simple and native contrivances and a bamboo is used to keep separate and distinct the two lines of warp as 'shed' is formed between

which the weft may be passed. The finely split, coloured or uncoloured sedge which forms the weft, is inserted by the needle-like shuttle, after the 'shed' has been formed and the 'beating up' is done by the reed which is moved forward and backward by which each weft is woven into its position in the mat. As weaving progresses, the tripod-stand, which carried with it the reed and other simple devices for 'shedding', is moved gently forward from one end of the loom to the other.

The superfine sedge mats are manufactured only in Pattamadai village and nowhere else in India. There are over 220 looms at Pattamadai village alone. But not all of them are employed for weaving superfine mats. The following table indicates the number of looms and the quality of mats woven in some of the villages in the District surveyed.

TABLE I

Village		Counts of Mats Woven	Number of Looms	Total Number of Looms	
1. Pattamadai	..	140-90	40	170 } 220	
..	..	80-30	30		
..	..	30	100		
..	..	Coarse below 30	50		
2. Harikesanallur } Veeravanallur } Shermadevi }	..	30-50	..	In large numbers	
3. Mudaliarpatty } Pettai } Kalakad }	..	Below 30	..	In large numbers	
Kayathar	..	Below 30	..	Largest numbers	
4. Melappalayalm } Seval } Kottur } Tirunelveli } Palamcottai } Srivaikuntam } Veeralam } Nanguneri } Ambasamudram } and in all other } Muslim centres }	..	Below 30	..	In smaller numbers	

The cost of preparing a loom varies, according to the count of mat required to be woven. The current estimates are ascertained to be Rs.30 per loom for rough varieties, Rs.50 for medium ones and about Rs.75 for fine and superfine varieties. The maintenance of a loom, however, is very cheap being usually not over Rs.5 annually. The pests against which the sedges and the looms are to be protected are cockroaches and white ants. The prepared sedges should be used within one year, and stacking them for longer periods is not recommended.

The time taken for each kind of mat to be woven also varies, dependent on the quality, the patterns, and other workmanship involved. Ordinarily, rough quality mats are woven one or two per day. For other quality mats, assuming that 6 hours are devoted every day, the time usually taken for preparing a mat is as follows:

For 40 counts mats	..	5 days
90-100 counts mats	..	20 „
110-120 counts mats	..	25 „
140 counts mats	..	30 „

The superfine mats are usually of simple pattern, mostly with the natural colour of the sedge itself for a greater portion, except for elegant bands of small width at either ends, with orange, green, red and purple colours. Occasionally, however, the entire length of the mat is prepared of bands of equal width, but with different colours alternating giving the product a very pleasing striped effect. Medium quality mats are woven with different patterns and with all colours indicated above. Fine and superfine mats are at times worked up with letterings and namings, with fine silk or fine cotton yarn or both. The naming is done by men (Figs. 13, 14). Weaving is mostly by women, although men also weave mats as occasion demands. The weaving is done practically throughout the year but during the rainy seasons, the progress is rather slow. The children from 12 years are trained to weave mats and in many Muslim centres mat-weaving is the mainstay of the community.

The mat-weaving industry in the Tirunelveli District is practically in the hands of middle and lower class Muslims of the place, who are called by the general term 'Lebbai'. They speak Tamil, and their dresses are simple. At Pattamadai, there are about 25 families who weave the fine and superfine varieties of mats. The superfine varieties are known from the village Pattamadai for over one hundred years at least. Among the families noted in the village for superfine quality mat-weaving, in the earlier years, are those of Syed Hussain Lebbai, Syed Nahur Mira Lebbai, Syed Mira Lebbai, Syed Haliba Mira Lebbai, Syed Jamalludin Lebbai, Mohammed Ibrahim Lebbai, Syed Kadir Mira Lebbai. Among the existing families may be mentioned those of Syed Peer Mohamed Mohideen Lebbai and E. S. Mohammed Ibrahim Lebbai. The average wages for weaving mats varies from 8 to 12 annas per day, and in exceptional cases even up to Re.1-8-0 per day.

All fine varieties and those above 30 counts are finally polished with a polishing stone (Fig. 11). A plank is held below the mat, while still on the loom, and the mat is pressed firm and flat against the plank. With a finely polished pebble of convenient size, the surface of the mat is stroked several times, when the mats obtain a glossiness. After polishing, the mats are removed from the loom and the edges are trimmed and worked up with fine thread or silk as the case may be. The price of each mat varies from Rs.3 to Rs.200 or more according to the quality and workmanship. The fine and superfine mats are usually of the size 30" × 66½" while medium and coarse varieties are of slightly larger size being 36" × 70". Besides these two standard sizes, mats are woven of different sizes but they are all of coarse and inferior varieties only.

The trade in these mats is referable to three sections, viz. (a) internal trade or local consumption, (b) inter-State or inter-District trade, adjusting the balance of local demand and (c) foreign trade (export) to other countries. Besides the local consumption, the mats of all varieties are sent out to various places for marketing, and in South India the principal centres to which the mats are exported are Tuticorin, Travancore Cochin, Alleppey, Madura, Trichy, Madras, Bezwada and other places. The principal foreign markets for Pattamadai mats are in Ceylon and America.

The table below gives a general idea of the various aspects of the industry.

The Pattamadai weavers are very conservative. They weave mostly mats, and occasionally they prepare hand-bags, pillows, purses and other fancy articles which are, however, also made to order only.

At Pattamadai, there is a Pattamadai Mat-Weavers' Association registered under the Society's Registration Act XXI of 1860. The entrance fee for membership is Rs.20, with a monthly subscription of 4 annas. Muslim men and women of 18 years and above in the District are eligible to become members and in 1952, there were about 107 members in that Association.

The Mat-Weaving Industry especially the superfine mat industry at Pattamadai is passing through a difficult phase. With the present higher cost of installation and production, and lesser actual production, necessitated by comparatively poorer consumption and negligible export, this famous cottage industry would seem ultimately to pass on to a stage of extinction. Though there have been some co-operative efforts to protect the industry, through registered organizations, etc., nothing could perhaps be said to have been done to promote its growth in a planned way. In the more recent years there has also been a serious decline in the enthusiasm of the younger generations to follow the traditional industrial pursuits. Many have taken up alternative occupations and school education. There is thus an urgent need to protect the industry and popularize the products by effective and lasting means. The products woven by these weavers are no doubt most elegant and eminently suited for decorative purposes and, in appreciation of the high-class workmanship, several gold medals and prizes have been awarded for these products, both in our country and abroad. These mats can be put to a variety of uses for furnishing drawing-rooms as coverlets for tables and other furniture, for decorations, and as door and window curtains and drops, bed-covers, and as bed-spreads, etc., and for making several fancy articles. As such their production should be encouraged for large-scale consumption as utility articles. When this is done, quite apart from the utilitarian aspect, there is also the humanitarian element, for every pie we spend on such cottage industry products goes to feed the poor workers in the village and helps to stabilize and build the renowned century-old industry.

SUMMARY

1. The great antiquity of grass and sedge mats in India is described with references to some of the ancient classical literature and also early sculptures of the second century B.C. and first and third centuries A.D.

2. A detailed account of the sedge mat industry of Pattamadai, a village in Tirunelveli District, South India, is given. The growth, harvesting, sizing and sorting of *Cyperus corymbosus* Rottb. which forms the basic raw-material of the sedge mats of Pattamadai are described in detail.

3. The special processing methods of trimming, splitting, retting and dyeing of *Cyperus* fibres are dealt with in detail. The trimmed and sorted out *Cyperus* culms are split first into two halves and sun-dried, and then retted for three or seven days in clear running water in streams. The fibres retted for three days are used for coarse mats, while the fibres retted for seven days are alone suitable for fine quality mats.

4. The construction of the loom and the weaving processes of fine quality mats are described in detail.

5. Statistical data as to the number of looms and the counts of mats woven in the different villages in the district are given. Also the total area of crop, and the total value of mats of coarse and finer qualities produced in the various villages in the district are mentioned.

6. The setbacks in the industry and the encouragement it deserves to protect the industry from being neglected and lost is briefly discussed, especially as the products, particularly the superfine quality mats of the district, have won great admiration from various countries for several years in the past.

EXPLANATION OF FIGURES

- FIG. 1. Bodhisattava receiving grass from Swastika.
FIG. 2. General aspect of *Cyperus corymbosus* Rottb. fields, in and along the River Tambarabarani.
FIG. 3. *Cyperus corymbosus* growing as tussocks in small islots in the River Tambarabarani.
FIG. 4. Harvesting *Cyperus corymbosus* for mats.
FIGS. 5 and 6. Sorting out the harvested sedges.
FIG. 7. Making bundles of the sorted sedges.
FIG. 8. Splitting the harvested sedges.
FIG. 9. Splitting the sedges into fine strands for the weft, after retting.
FIG. 10. Weaving a mat in the loom.
FIG. 11. Polishing the surface of the woven mat in the loom.
FIG. 12. A loom with a mat almost completed.
FIG. 13. An unfinished mat with letterings.
FIG. 14. A finished mat of striped variety with letterings.
FIG. 15. *Cyperus corymbosus* fibres, raw and processed.
FIG. 16. Scythe and splitting knife used in the mat industry.



1



2



4



3



6



8



5



7



10



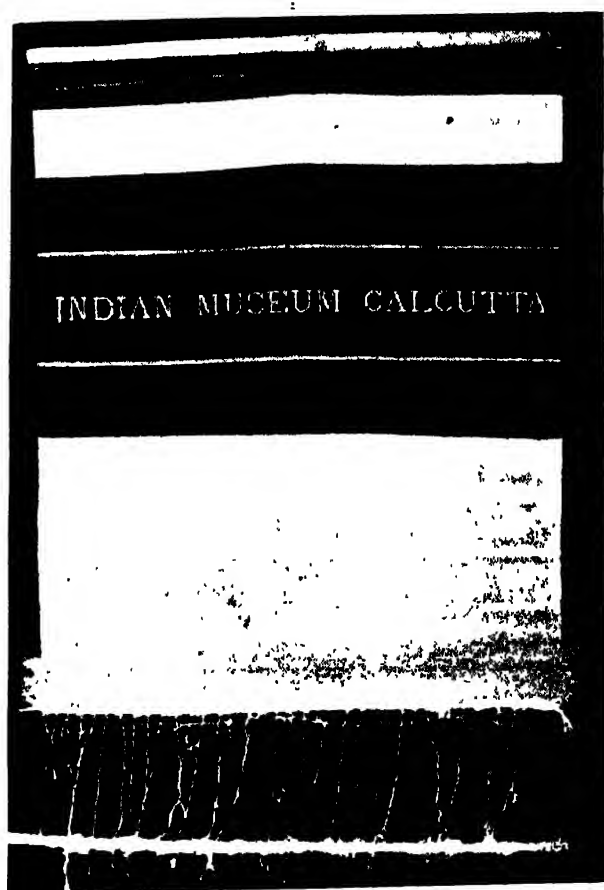
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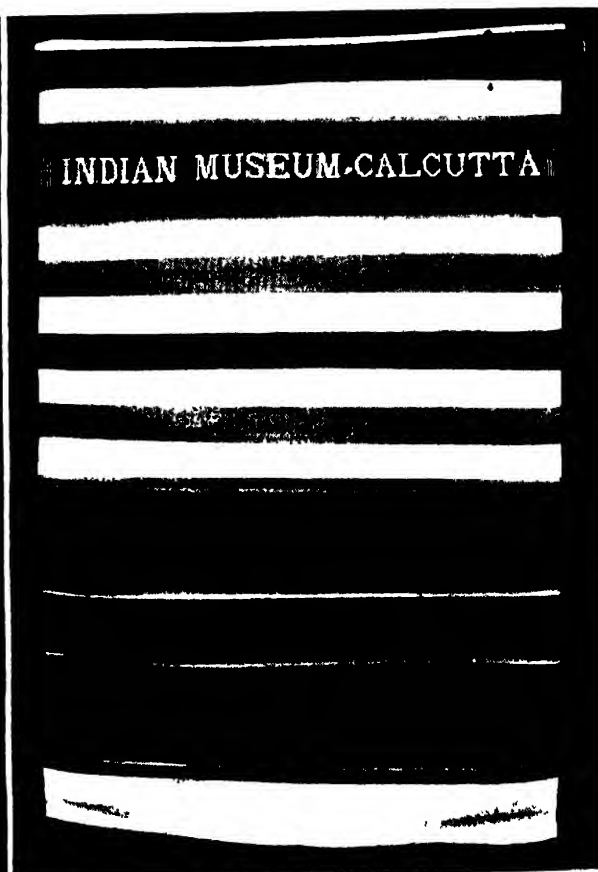
9



11



13



14



15



16



Fig.-17. *CYPERUS CORYMBOSUS* Rottb.

1"

COPPERPLATES OF SALINGSINGAN 802 ŚAKA AND OF
°KIKIL BATU 827 ŚAKA FROM CENTRAL JAVA

By HIMANSU BHUSAN SARKAR

The find-spot of these plates is not known, but from reference to the names of Kamalagyan, Panggumulan and the bhaṭāra of Salingsingan, the plates appear to refer to Central Java, perhaps the region of Kědu.¹ The inscription is incised on two copperplates measuring 39×15 cm. It has been stated by Cohen Stuart² that Pl. 1b, which is illegible in many parts, has perhaps been copied on Pl. 2. In the following transcription, Pl. 2 is described with additions from Pl. 1b where it is legible. The plates were purchased by the Batavia Society in 1864.³ A second inscription dated 827 Śaka has been incised in continuation of the first inscription.

The inscription incidentally states that the *Raka* of Kayuwangi contributed to the presentation of gold articles to the bhaṭāra of Salingsingan in 802 Śaka. The main interest of the inscription, however, lies elsewhere. It seems that the orders of the Pangaruhan regarding feudal obligations to be paid to the king were not adequately discharged by the people of some villages. Hence these obligations were fixed under royal command and people were asked not to oppose the Pangaruhan in this matter. An additional interest of the inscription is created by the reference to some villages which were specially inhabited by particular classes of smiths. The second inscription describes a feast given to some village-headmen, but the motive for arranging this feast is not stated in the inscription.

The transcription and facsimile of this inscription have been published in *KO*, X and partly by Damais in *BEFEO*, 47 (1955), pp. 45-46. Due to the difficulty of the old Javanese text, its meaning has not yet been properly understood and no attempt has hitherto been made to offer a translation. The text of the inscriptions and provisional translation of the same are now offered below to stimulate further discussion on these difficult records.

Text

- 1a. 1. swasti śakawarṣātita duāmwilan. atus. aliḥ baiśākh māsa,
 tithi caturdaśi⁴ kṛṣṇapakṣa, tu, u, so, wāra. tatkāla sang
 pangaruhan. pu ca
2. kra⁵ mamuat. gawai warangbang mas. tunggal, brat
 sānggappan.⁶ kati, rambutnya udi,⁷ payung pirak.
 mawangku maḍanda mapuñcak. mas tunggal. brat sa
3. nggappan. kati masnya udi⁸ tigang kati punya śrī mahā-
 rāja rakai Kayuwangi i bhaṭāra i salingsingan. rikana kāla
 sang pangaruhan. dinamakka

¹ As some personal names of this inscription also appear in the record from Papringan (Jogjakarta), Dr. Stutterheim supposes (*TBG*, 73, p. 100, f.n. 1) that the inscription under review may be derived from that region, viz. Jogjakarta Prambanan.

² *KO*, p. x, 21 f.n.

³ See *Notulen*, II, pp. 32, 58.

⁴ Read: °daśi.

⁵ °tra ? (C. Stuart = CS).

⁶ CS reads sang° but sāng° is clear on the facsimile.

⁷ dadi ? (CS).

⁸ dadi ? (CS).

4. n.¹ tan katamāna daining paraṇakkan. muang sikappan. halu warak. kring patinghalan. paḍammapuy. walyan. muang rumwān. sahana
 5. ning punpunan. nira paṇḍai tambaga gangśa i panggumulan. i handanuan. i kamalagyan. i gulung i talaga sapradeśa ning manghu
 6. ju(ng ?) karang taku jati luītan. kuningan. suṇḍa hujung ganggā sakweḥ ning tumūt. inatag. mabuat hajya i watan-gan. irikānni
 7. nuwaḥhakan. kinon. muliha ikanang inambil. mangintaya ngaranya si tēkēs. rai kris. muang rai bañcar. anung inala
 8. p. haji umintaya anak. rakai gunung. pu bhaitā, ngaran nikanang paraṇakkan. sang rakinam. patih i pungsur. manurunnakan.
 9. ujar haji sang manguñjikan. pu² lugi samgat. paḍaḍah mamwang ākāśa samgat. manimpiki pu acung mataṇḍa i manimpiki rikanang kāla
 10. pu sugēt. parujar. pūliḥ tuhān. i pangaruhan. piwujuk. manurat. citralekha ing ngumah mas. pun tanggeḥ wangi matang ya
 11. daiyaning anak bānua³ sahanan⁴ ing ataggan. sang pangaruhan. kabaiḥ prayatnā ring ujar haji tan wihanga sapra-kāra ning pangatag.
- 2 (and 1b)
1. sang pangaruhan. rāmanta i pangaruhan. milu manadāḥ ujar haji, pu majēt. tuha kalang pu lucira. guṣṭi⁵ pu astuti,
 2. muang pu sudhara parujar. pu dhiti. winkas. pu mula,⁶ wariga pu dayana,⁷ tuha wērēḥ pu bamī muang pu ayana, rāma ma
 3. ratā kakī swaṣṭi, pu do, tuha gusali pu mātra, tuha kalang i kamalagyan. pu śānta, guṣṭi pu uṇḍal, parujar. pu pu
 4. ṇjang, winkas. pu parasi. sang ragugur. tuha gusali rāma ni⁸ sarad. tuha kalang pu talaga. pu sangka rama ni catha guṣṭi⁹ pu pingul. rama ni
 5. astira, parujar. pu liwū¹⁰ rama ni rakṣaṇa, tuha gusali pu sangka rama ni mūla,¹¹ winkas. pu hli rama ni tunggū, rāma maratā pu¹² basa rama ni sa
 6. ṇjaya, nāanunghana de sang pangaruhan. prayatnā¹³ ring¹⁴ ujar haji nguniwaiḥ rakryan. mawanua tan tamā ri atanggan.¹⁵ sang pangaruhan.

¹ The duplication of the consonant in the inscription deserves attention.

² bu ? (CS).

³ CS reads ba° but bā is clear on the facsimile.

⁴ CS reads saḥā° but there is no sign for the medial ā.

⁵ Pl. 1b has the usual spelling of °sti.

⁶ Pl. 1b: mukha ? (CS).

⁷ Uyana ? (CS).

⁸ The word ni originally left out has been inserted over the top.

⁹ lb: °sti.

¹⁰ lb: bū ? (CS).

¹¹ lb: mu° ? (CS).

¹² bu ? (CS).

¹³ lb: °na.

¹⁴ lb: ri ? (CS).

¹⁵ atanggan ? (CS). Read: °agan.

7. sang pangaruhan. atah pramāṇā iriya, swasti¹ śakawar-satīta² 827³ mārggaśiramāsa tithi⁴ caturdaśi⁵ kṛṣṇa,⁶ mapa. wṛ. wā
8. ra tatkāla sang tuha gusali rama ṇi⁷ ikā mawaiḥ manadaha i rāmanta i kikil batu makabaihan. majaryyakan. sira haḍa
9. ngan, patih rikāṅg kāla pu katang rama ni dawa,⁸ kalang pu gubāṅg, guṣṭi pu bangklō, winkas. pu pradū, rāma kaki atī, kaki
10. nang, pu (?) jinti, pu kamala, pu kamali, pu parahita, kala(ng ?) i kakaran. pu tguḥ winkas. pu ikā, hulutarus.⁹ i suru tba
11. 1. pu mangol.¹⁰

Translation

- 1a.
1. Hail! the śaka year expired, 802,¹¹ the month of Vaiśākha, fourteenth day of the dark half of the month, *tunglai*,¹² *umanis*,¹³ Monday. At that time *sang pangaruhan* (viz.)
 2. Pu Cakra brought in as works of art (for religious purposes): a *warang bang*¹⁴ of gold weighing nine *Kati* whereof the *rambut*¹⁵ was tested (?), a silver umbrella with a band (which serves to close the umbrella), stick with one upper knob (made of) gold, weighing nine
 3. *Kati*. Of this tested (?) gold, three *kati* are the meritorious gift of the illustrious great king, the raka of Kayuwangi, to the *bhaṭāra*¹⁶ of Salingsingan. At this time,¹⁷ *sang Pangaruhan* received (the royal favour whereby he)
 4. shall not be interfered with by the *paranakan*¹⁸ and *sikēpan*,¹⁹

¹ Read: swasti.

² The correct Skt. form is: °śā°.

³ CS: or, 847? cf. *KO*, p. x. Damais reads the date as 827.

⁴ This lacks in lb.

⁵ The correct Skt. form is °rdaśi.

⁶ Read: Kṛṣṇa. lb has 'Kṛṣṇapakṣa, mawulu, pahing wṛspati ...'

⁷ lb: bapa ni.

⁸ uwa? (CS).

⁹ lb: °turus.

¹⁰ This may be jointly read from lb and 2.

¹¹ The digits have been put in words. See Damais in *BEFEO*, 46 (1952), p. 38,

f.n. 3.

¹² A Mal.-Polynesian day of the six-day week.

¹³ A Mal.-Polynesian day of the five-day week.

¹⁴ Its significance is not quite clear.

¹⁵ For remarks on this word and the passage, see Stutterheim in *TBG*, 65, pp. 228-30

f.n.

¹⁶ *Bhaṭāra* = deity or the apotheosized king. It is difficult to say which one has been intended in our text. On the custom of deification, see Coedès in *BCAI*, 1911, pp. 38-49, and Krom: *Geschiedenis*, pp. 8, 180ff.

¹⁷ From this place up to l. 9, one can translate the inscription differently according to his conception of the construction of sentences.

¹⁸ According to Kern, 'cross-breed persons'. This interpretation does not appear satisfactory to me, as it does not suit the context in *OJO*, XXXVI: V° 1. For Stutterheim's notes, see *TBG*, 65, pp. 247-48.

¹⁹ In *TBG*, 67, p. 175, f.n. 7, Stutterheim says that the term reminds one of the significance of amulet = *sikēp* or *sikēpan*. See hereover *BKI*, 3: XI, p. 344. Amulet-makers?

*halu warak*¹ *Kring*,² *patinghalan*,³ *paḍamapuy*,⁴ *walyan*⁵ and *rumwān*⁶. (Now) all people

5. subservient to him (viz.) the copper-smiths (and) brass-smiths of Panggumulan,⁷ of Handanuan, of Kamalagyan,⁸ of Gulung, of Talaga (and) all the places of
6. Manghuju(ng),⁹ Karang, Taku, Jati, Luitan, Kuningan, Sunḍa, Hujung Ganggā¹⁰ (and) all people of Tūmūt were called for feudal obligations (to be paid) at the audience-hall (of the King). At this place,¹¹ the (feudal) charges
7. were framed, demanded (and) received. After seeing the persons called *Si Tēkēs*, the Hon. one from Kris (*ra i Kris*) and the Hon. one from Bañcar (*ra i bañcar*), who were approved¹²
8. by the king, he¹³ saw the son of the *raka* of Gunungan (viz.) *Pu Bhaitā* (and) the person holding the office of the *Paranakan* (viz.) *Sang Rakinam*, the *patih*¹⁴ of Pungsur (and) communicated
9. the royal orders (to) *sang manguñjikan*¹⁵ (viz.) *Pu Lugi*, the *samgat*¹⁶ (of ?) *Paḍaḍah* (namely ?) *Mamwang ākāśa*, the

¹ The Bal. Gloss has *juru pangajah* (Pēngajah = liable to service). See Stutterheim: *TBG*, 65, p. 249. According to V. d. Tuuk (*KBWdb.*, III, p. 715), the term denotes 'persons from the retinue of the king rendering services as director of the Orchestra, *Wayang* and other entertainments'. See also the notes of Kern: *VG*, VII, p. 47.

² Kern (*VG*, VII, pp. 24, 47) translates the term by 'decrepit'. According to Stutterheim (*op. cit.*, p. 246) it may be a title like *juru*, but its significance is not known (*TBG*, 75, p. 435).

³ A class of inspectors.

⁴ It literally means 'the extinguishing (of) fire'. The idea is not, however, applicable here. Apparently the term denotes a class of people or officers. Kern (*op. cit.*, p. 47) thinks, however, that the term may refer to 'houseless persons', but his interpretation has been plausibly criticized by Stutterheim: *op. cit.*, p. 247.

⁵ This corresponds to *Pawalyan* of other inscriptions. The term may perhaps refer to a male *dukun*. See hereover Kern: *op. cit.*, p. 49; Hazeu: *Het. Jav. tooneel*, p. 49, f.n. 3; Pigeaud: *Tantu*, p. 285; Stutterheim: *op. cit.*, pp. 264-65.

⁶ The significance of the term is not quite clear, though it may be connected with a class of people associated with precious stones. See *TBG*, 65, p. 256.

⁷ Panggumulan perhaps lay in Sleman in the district of Klegung. The name Panggumulan is also mentioned in the inscription of Kēmbang Arum (*OV*, 1925, Bijl. B).

⁸ This place is probably mentioned in the inscription of Kuburan Caṇḍi. See *TBG*, 70, pp. 157, 167-68.

⁹ Excepting probably Kuningan and Sunḍa, it is difficult to say where one name begins and ends.

¹⁰ It is difficult to say if Hujung Ganggā should be separated into two names.

¹¹ The intention seems to be this: the people who had collected at that place, i.e. at Salingsingan, had, by mutual discussion, fixed their feudal obligations to be paid to the king. As these obligations were entered into in a religious place, these were considered to be binding on the people concerned. It may also refer to the audience-hall of the king which might not have been far off from Salingsingan.

¹² I do not understand what this approval refers to. Were these persons approved because they were to look after the collection of feudal dues for the king?

¹³ This appears to refer to *sang pangaruhan*.

¹⁴ The *Patih* of this time is a petty officer. He is certainly not like the great *patihs* under Dakṣa, Balitung, etc. Cf. Goris: *TBG*, 70, p. 163.

¹⁵ An officer of unknown functions. Festoon-makers for the Kris?

¹⁶ The word is spelt in various ways, e.g. *samgēt*, *samēgat*, etc., and corresponds to *pamgēt*, *paṁēgat*. The term denotes a notable person. See also *BKI*, 90 (1933), pp. 241-44, 257-58 with literature cited thereon.

*sangat manimpiki*¹ (viz.) *Pu Acung*, the *matanda*² of the *manimpikis* of this time (viz.)

10. *Pu Sugēt*, the *Parujar*³ of *Pūlih*, the *Tuhān* of the *pangaruhan* (namely ?) *Piwujuk*⁴ (and) the writer, the *citrakēha* of *Ngumah mas*⁵ under (?) *Tanggeh wangi*.⁶ The reason why
11. the service of all the *anak banuas* (i.e. villagers) was requisitioned by *sang pangaruhan* is that all shall take care of the royal command without offering any kind of opposition to the exhortations of
- 2 (and 1b) 1. *sang pangaruhan*. The *rāmantas*⁷ (i.e. village officials) under *Pangaruhan* (who) went to receive the royal command were: *Pu Majēt*, *tuha kalang*⁸ (viz.) *Pu Lucira*, the *gusti*(s) (viz.) *Pu Astuti*,
2. and *Pu Sudhara*, the *parujar* (viz.) *Pu Dhiti*, the *winkas*⁹ (viz.) *Pu Mula*, the *wariga*¹⁰ (viz.) *Pu Dayana*, the *tuha wērēh*(s)¹¹ (viz.) *Pu Bamī* and *Pu Ayana*, the *rāma maratā*(s)¹² (viz.)
3. *Kakī*¹³ *Swastī* (and) *Pu Do*, the *tuha gusali*¹⁴ (viz.) *Pu Mātra*, the *tuha kalang* of *Kamalagyan* (namely ?) *Pu Śānta*, the *gusti* (viz.) *Pu Uṇḍal*, the *parujar* (viz.) *Pu*
4. *Puñjang*, the *winkas(es)* (viz.) *Pu Parasi* (and) *Sang Ragugur*, the *tuha gusali* (who is) the father of *Sarad*, the *tuha kalang* (viz.) *Pu Talaga*, *Pu Sangka* (who is) the father of *Catha*, the *gusti* (viz.) *Pu Pingul* (who is) the father of
5. *Astira*, the *parujar* (viz.) *Pu Liwū* (who is) the father of *Raksaṇa*, the *tuha gusali* (viz.) *Pu Sangka* (who is) the father of *Mūla*, the *winkas* (viz.) *Pu Hli* (who is) the father of *Tunggū*, the *ramā maratā* (viz.) *Pu Basa* (who is) the father of *Sañjaya*.
6. Now these (officers) were asked (?) by *sang pangaruhan* to take care of the royal command. So also the *rakryan mawana*¹⁵

¹ Cabinet-makers? See *KBWdb.*, IV, p. 521; *TBG*, 65, p. 250.

² He seems to be the headman.

³ Proxy, spokesman. *Parujar*=*Paruwus*. Cf. Stutterheim in *TBG*, 73 (1933), p. 100.

⁴ Or: ... 'the *pangaruhan*, also *Wujuk* ...'

⁵ Literally, 'the house of gold'.

⁶ Or: 'the *punta* of *Geh-wangi*'.

⁷ See *TBG*, 73 (1933), p. 100ff.

⁸ The older of the *kalangs*. Their functions are unknown. In *KO*, XI, they are referred to as *tuha kalang*, *hyang kalang* or simply as *kalang*.

⁹ Kern (*VG*, VII, p. 43) translates the word by 'clerk', Dr. Stutterheim (*TBG*, 73, p. 100) by 'substitute'.

¹⁰ The term may refer to astrologer.

¹¹ Literally, *tuha wērēh* is the chief over young (unmarried) persons. Dr. Goris says (*TBG*, 70, p. 164) that in the temples of North Bali at the present day, visitors are divided as adult men, married women, unmarried youths and unmarried girls. At the head of one such group stood the *tuha wērēh*.

¹² Inspector of vehicles? Inspector of plains?

¹³ Older of the *desa* or grandfather. Re: *Kaka*, *Kakang*, *Kaki*, etc., see *TBG*, 70, p. 160, f.n. 1; *BKI*, 101 (1942), pp. 95-96. It occurs in the inscription of *Kuburan Candi* (*TBG*, 70, pp. 157-70); *KO*, XIV; *OJO*, XVI, etc.

¹⁴ The same as *juru gosali* (*gusali*), i.e. chief of smiths.

¹⁵ Official connected in some way with village administration.

- (was asked) not to interfere with the jurisdiction of *sang pangaruhan*, (because)
7. *sang pangaruhan* is the sole authority over this. Hail! the Śaka year expired, 827, the month of Mārgaśīra, fourteenth day of the dark half of the month, mawulu,¹ pahing,² Thursday.
 8. At that time, *sang tuha gusali*,³ the father of Ikā, offered foodstuffs⁴ to all the *rāmantas* of Kikil batu: he fed (?) them with buffaloes.
 9. The *patih* of the time (viz.) *Pu Katang*, the father of Dawa, the *Kalang* (viz.) *Pu Gubāng*, the *gusti* (viz.) *Pu Bangklö*, the *winkas* (viz.) *Pu Pradū* (who is) the father of *Kaki Atī*, the *Kaki(s)* (viz.)
 10. *Pu Jinti*, *Pu Kamala*, *Pu Kamali*, *Pu Parahita*, the *kalang* of Kakaran (namely ?) *Pu Tguh*, the *winkas* (viz.) *Pu Ikā*, the *hulutarus*⁵ (?) of Suru (?) tbal,
 11. *Pu Mangol* (?). . . .

¹ A Mal.-Polynesian day of the six-day week.

² A Mal.-Polynesian day of the five-day week.

³ The same as *juru gusali*.

⁴ The motive or occasion for this feast has not been described.

⁵ A class of officers or people ?

FINGER DERMATOGLYPHIC STUDY OF THE RIANGS OF TRIPURA

By SALIL KUMAR BASU

(Communicated by Professor N. K. Bose)

The present study deals with the Riangs (38,556* in 1951), one of the aboriginal tribes of Tripura State. The material was collected from Bogapha in the Belonia Subdivision by Dr. A. K. Mitra, Ex-Deputy Director of the Department of Anthropology, to whom the author is thankful for allowing the latter to analyse the data and report. Finger prints of unrelated individuals have been chosen from the original collection in order to avoid the familial peculiarities masking the very characteristic of the group. The present material consists of 910 finger prints of 91 unrelated individuals (68 males and 23 females). Identification and analysis of the finger prints have been done according to methods devised by Cummins and Midlo (1943).

Analysis of the data

PAPILLARY PATTERNS

The finger prints of the two sexes are shown separately in Tables 1A and 1B.

TABLE 1A
Distribution of papillary patterns

	Males										
	Left					Right					
Pat-terns	I	II	III	IV	V	I	II	III	IV	V	Total
Whorl	34	32	22	39	16	42	29	25	44	21	304
Per cent	5.00	4.71	3.38	5.73	2.35	6.18	4.27	3.68	6.47	3.08	44.71
Loop											
radial	..	9	1	1	1	..	8	..	..	..	20
Per cent	..	1.32	0.15	0.15	0.15	..	1.18	..	..	..	2.95
Loop											
ulnar	34	23	45	27	50	24	25	41	24	47	340
Per cent	5.00	3.38	6.62	3.97	7.35	3.53	3.68	6.03	3.53	6.91	50.00
Arch	..	4	..	1	1	2	6	2	..	..	16
Per cent	..	0.59	..	0.15	0.15	0.29	0.89	0.29	..	..	2.36
Total	68	68	68	68	68	68	68	68	68	68	680

It will be observed from Tables 1A and 1B that the females exhibit a comparative higher frequency of whorls (50.00 per cent) and lower frequency of arches (1.29 per cent) as compared to males, who show them in 44.71 per cent and 2.36 per cent respectively. It is to be noted that in the females the frequencies of whorls (50.00 per cent) and loops (48.69 per cent)

* Figures had been supplied by the Statistical Section of the Tripura Government.

TABLE 1B

Females

Pat- terns	Left					Right					Total
	I	II	III	IV	V	I	II	III	IV	V	
Whorl	15	15	10	11	4	18	15	7	16	4	115
Per cent	6.52	6.52	4.35	4.78	1.74	7.83	6.52	3.04	6.96	1.74	50.00
Loop											
radial	..	1	..	..	..	..	1	..	..	..	2
Per cent	..	0.43	..	..	..	..	0.43	..	..	..	0.86
Loop											
ulnar	7	6	13	12	19	5	6	16	7	19	110
Per cent	3.04	2.61	5.65	5.22	8.26	2.18	2.61	6.96	3.04	8.26	47.83
Arch	1	1	..	..	..	..	1	..	..	..	3
Per cent	0.43	0.43	..	..	..	..	0.43	..	..	..	1.29
Total	23	23	23	23	23	23	23	23	23	23	230

are almost equal in comparison to the males (whorls 44.71 per cent, loops 52.95 per cent). Radial loops appear to be more frequent in males (2.95 per cent) than in females (0.86 per cent). Moreover in females, radial loops are found to occur exclusively on digit II (0.86 per cent), while in males, though the maximum incidence is on digit II (2.50 per cent), there are solitary cases of occurrence of radial loops on digits III (0.15 per cent), IV (0.15 per cent) and V (0.15 per cent).

TABLE 2

Comparative occurrence of whorls and loops (R+U) in different digits

Digit	Males				Females			
	Lt.	Rt.	Rt.-Lt. com- bined	W-L ratio	Lt.	Rt.	Rt.-Lt. com- bined	W-L ratio
I	W = L	W > L	W > L	1 : 1.31	W > L	W > L	W > L	1 : 2.75
II	W = L	L > W	L > W	1 : 1.06	W > L	W > L	W > L	1 : 2.14
III	L > W	L > W	L > W	1 : 1.85	L > W	L > W	L > W	1 : 1.71
IV	W > L	W > L	W > L	1 : 1.60	L > W	W > L	W > L	1 : 1.42
V	L > W	L > W	L > W	1 : 2.65	L > W	L > W	L > W	1 : 4.75

Table 2 shows that the general order of the comparative occurrence of whorls and loops varies to some extent in the individual digits. The order $L > W$ has been found to exist in II, III and V digits in males while in other digits the order is reversed ($W > L$). In females, the prevailing order appears to be $W > L$ which occurs in I, II and IV digits. The combined loop-whorl ratio in males for the digits II, III and V varies between 1 : 1.06 and 1 : 2.65 with a mean of 1 : 1.85 whereas in females, the combined whorl-loop ratio for the digits I, II and IV varies between 1 : 1.42 and 1 : 2.75 with a mean of 1 : 2.08.

TABLE 3

Frequency of papillary patterns and the different indices derived out of them

	Whorl	Radial loop	Ulnar loop	Total loop	Arch	Pattern inten- sity index	Arch- whorl index	Whorl- loop index
Males	44.71%	2.95%	50.00%	52.95%	2.36%	14.23	5.28	84.44
Females	50.00%	0.86%	47.83%	48.69%	1.29%	14.87	2.58	102.69

It appears from the above table that the pattern intensity index is only slightly lower in males than in females. The arch-whorl index in females (2.58) is quite low as against 5.28 of males and this is due to the fact that the females possess a higher frequency of whorls (50.00 per cent) and lower frequency of arches (1.29 per cent) as compared to males. A comparative higher frequency of loops in the males (52.95 per cent as compared to 48.69 per cent in the females), however, resulted in a lower whorl-loop index in the males (84.44).

BIMANUARS

Heinrich Poll* proposed the construction of the bimanuars in which the three patterns (whorl, loop and arch) could be shown in a triangular pyramid. Figures 1 and 2 show the two bimanuars for the two sexes in which the present frequencies of different finger-print pattern combinations have been represented. The male bimanuar (Fig. 1) shows two peaks at 3W7L and 6W4L each showing a percentage of 11.76 whereas the female bimanuar (Fig. 2) displays three peaks at 3W7L, 4W6L and 6W4L each with a percentage of 13.63.

TABLE 4

Occurrence of total symmetry and asymmetry

Individuals	Symmetry	Asymmetry
Males	272 (80%)	68 (20%)
Females	89 (84.76%)	16 (15.24%)

The female Riangs appear to possess greater symmetry (84.76 per cent) than the males (80 per cent) and, accordingly, the frequency of asymmetry is higher in males (20 per cent) than the females.

Volotzkoy† has called a hand monomorphic as the one comprising the same finger-print pattern in all the five digits. A slight sexual difference is observed from Table 5 in frequency of monomorphic hands (4.70 per cent in males as against 3.04 per cent in females), whorls seem to

* Cited by Cummins, H., and Midlo, C. (1943)—Finger Prints, Palms and Soles.

† Cited by Cummins, H., and Spragg, S. D. (1938)—Dermatoglyphics in the Chimpanzee. *Human Biology*, 10, No. 4, p. 457.

LOOP-WOHL		MALE (68)									
10W		9W1A		8W2A		7W3A		6W4A		5W5A	
		7-35	8-82	5-88	5-88	11-76	2-94	10-29	11-76	5-88	4-41
9W1L		—	—	—	—	—	—	—	—	—	—
8W2L		—	—	—	—	—	—	—	—	—	—
7W3L		—	—	—	—	—	—	—	—	—	—
6W4L		1-47 (6W1A3L)	—	—	—	—	—	—	—	—	—
5W5L		—	—	—	—	—	—	—	—	—	—
4W6L		1-47 (4W1A5L)	—	—	—	—	—	—	—	—	—
3W7L		—	—	—	—	—	—	—	—	—	—
2W8L		2-94 (2W1A7L)	1-47 (2W2A6L)	—	—	—	—	—	—	—	—
1W9L		1-47 (1W1A8L)	—	—	—	—	—	—	—	—	—
10L		2-94	2-94	1-47	—	—	—	—	—	—	—
		9L1A	8L2A	7L3A	6L4A	5L5A	4L6A	3L7A	2L8A	1L9A	—

Fig. 1.

LOOP-ARCH

10W		FEMALE (23)										10L	
LOOP-WHOLE	9W1L	9W1A	8W2A		7W3A	6W4A	5W5A	4W6A	3W7A	2W8A	1W9A	10A	
	4.54	—	—	—	—	—	—	—	—	—	—	—	—
	9.09	—	—	—	—	—	—	—	—	—	—	—	—
	9.09	—	—	—	—	—	—	—	—	—	—	—	—
	4.54	4.54 (7W1A2L)	—	—	—	—	—	—	—	—	—	—	—
	13.63	—	—	—	—	—	—	—	—	—	—	—	—
	4.54	—	—	—	—	—	—	—	—	—	—	—	—
	13.63	—	—	—	—	—	—	—	—	—	—	—	—
	13.63	—	—	—	—	—	—	—	—	—	—	—	—
	9.09	—	—	—	—	—	—	—	—	—	—	—	—
LOOP-ARCH	4.54	—	—	4.54 (1W2A7L)	—	—	—	—	—	—	—	—	—
	4.54	—	—	—	—	—	—	—	—	—	—	—	—
10L		9L1A	8L2A	7L3A	6L4A	5L5A	4L6A	3L7A	2L8A	1L9A			

FIG. 2.

TABLE 5
Distribution of monomorphic hands

Males				Females		
Pattern	Lt.	Rt.	Total	Lt.	Rt.	Total
Whorl	9	10	19	2	2	4
Per cent	1.32	1.47	2.79	0.87	0.87	1.74
Loop ulnar	7	6	13	1	2	3
Per cent	1.03	0.88	1.91	0.43	0.87	1.30
Total	16 (2.35%)	16 (2.35%)	32 (4.70%)	3 (1.30%)	4 (1.74%)	7 (3.04%)

display a greater monomorphism than ulnar loops in males, while in females nothing can be said in view of the small number of monomorphic hands that occur in the sample.

PAIR-GROUP RULE

Application of Poll's Pair-Group Rule (Poll, 1938) in the male and female Riangs shows that the rule is valid in the case of males but void in females as shown by the following results.

TABLE 6
Application of pair-group rule

Individuals	ΣP	ΣG	$D = (\Sigma P - \Sigma G)$	Validity
Males	0.434	0.334	0.100	Valid or $\Sigma P > \Sigma G$
Females	0.81	0.92	-0.11	Void or $\Sigma P < \Sigma G$ (Σ = Summation)

Genotype, zygote and V, R, U factors

Genetic analysis of finger prints of 67 male Riangs and 20 female Riangs has been shown in Table 7.

In males, vv Rr Uu genotypic combination seems to occur in the highest frequency (i.e. 14.92 per cent), whereas most frequent occurrence in females is Vv Rr Uu genotype (25.00 per cent). Diversity of genotypes appears to be more in males than in females.

The genotypes VV RR UU, Vv rr uu, vv Rr uu, VV Rr uu, VV RR uu, VV Rr UU are all absent in females while they have been found to exist in very small percentages (i.e. 1.49 per cent) each in males.

It appears from Table 8 that thick epidermis (VV) is absent in females while it occurs in a comparatively lower frequency in males (i.e. 17.91 per cent). The percentage of recessive homozygote (vv) seems to be a little higher in female individuals (i.e. 50 per cent) than males (47.76 per cent). As regards radial cushioning, the dominant homozygote (RR) is

TABLE 7
Distribution of genotypes

Males			Females	
Genotypes	Absolute number	Per cent	Absolute number	Per cent
VV RR UU	1	1.49	—	—
Vv RR uu	5	7.46	—	—
Vv Rr uu	4	5.97	—	—
Vv RR Uu	4	5.97	3	15.0
Vv Rr Uu	6	8.95	5	25.0
Vv RR UU	3	4.47	—	—
Vv rr uu	1	1.49	—	—
Vv Rr UU	—	—	2	10.0
vv RR Uu	8	11.94	2	10.0
vv Rr UU	5	7.46	1	5.0
vv Rr Uu	10	14.92	3	15.0
vv RR UU	7	10.44	3	15.0
vv Rr uu	1	1.49	—	—
vv rr Uu	1	1.49	1	5.0
VV Rr uu	1	1.49	—	—
VV RR Uu	6	8.95	—	—
VV Rr Uu	2	2.98	—	—
VV RR uu	1	1.49	—	—
VV Rr UU	1	1.49	—	—

TABLE 8
Zygote frequencies in male and female Riangs

Males			Females	
Zygotes	Absolute numbers	Per cent	Absolute numbers	Per cent
VV	12	17.91	—	—
Vv	23	34.32	10	50.00
vv	32	47.76	10	50.00
RR	36	53.73	8	40.00
Rr	29	43.28	11	55.00
rr	2	2.98	1	5.00
UU	17	25.37	6	30.00
Uu	37	55.22	14	70.00
uu	13	19.40	—	—

higher in males (53.73 per cent) than among the females (40.00 per cent). Females possess more (55.00 per cent) heterozygotes Rr than the males (43.28 per cent). Ulnar cushionings appear to be heterozygotic (Uu) in the highest percentage in both the sexes.

The distribution of factors V, R and U is shown below:—

TABLE 9
Distribution of factors V, R and U

Factors	Males per cent	Females per cent
V	35.07	25.00
v	64.92	75.00
R	75.37	67.50
r	24.62	32.50
U	52.98	65.00
u	47.01	35.00

Individual quantitative values

	Males		Females
Maximum value	22.6	Maximum value	19.4
Minimum value	1.9	Minimum value	8.2
Range	20.7	Range	11.2

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A NĀGĀRJUNAKONDA INSCRIPTION OF
VĪRAPURUṢADATTA

By BRATINDRA NATH MUKHERJEE

A very interesting stone-pillar inscription has been found at Nāgārjunakonda during an excavation of the historical remains during the season 1956-57. The record is being edited for the first time here with the help of a photograph, published in *Indian Archaeology*, 1956-57—*A Review* (36 and Pl. LVIII).

The inscription consists of eleven lines, written in Brāhmī script of southern variety, prevalent in Andhradeśa in the third century A.D. Its language is nearly pure Sanskrit, though influence of Prākṛit is quite discernible. As regards orthography, it should be noted that there is a tendency to double the consonants before *ra* (*Puṣpabhaddra* in l. 1, *puttreṇa* in l. 8, etc.). Sometimes genitive singular or plural forms are reached by adding *ya* and *visarga* after the words concerned (*bhāgineyyaḥ* in l. 7, *Kupaṇaśrīyāḥ* in l. 8, etc.).¹

The subject of the inscription is to record the erection of a temple of Mahādeva, called Puṣpabhadrasvāmin, the consecration of the pillar bearing this record as *dhvajastambha* in the temple and the perpetual endowment of a village, for the maintenance of the temple. Obviously the revenues, collected from the village, would be spent for this maintenance.

Our record indicates that the name of the dynasty, to which it belongs, is to be spelt as Ikṣvākū² and not as Ikṣvāku as is generally done. The inscription is dedicated in the 16th or the 18th³ regnal year of Caṁtamūla II of the Ikṣvākū royal family who ruled in the Nāgārjunakonda region in the third century A.D. The donor of the record is Vīrapuruṣadatta (II), the son of Caṁtamūla (II) and Kupaṇaśrī. This Vīrapuruṣadatta was probably the same as Puruṣadatta, the son of Ehuvala Caṁtamūla (II), referred to in the pillar inscription found at Nāgārjunakonda during the year 1957-58.⁴ The latter epigraph also refers to the construction of a temple of the god Puṣpabhadra and the erection of a *dhvajastambha* in the 16th regnal year of Ehuvala Caṁtamūla II. It is not unlikely that both the epigraphs

¹ Dr. D. C. Sircar observes that, like the Sātavāhana and other early Prākṛit records, the Ikṣvākū inscriptions express compound consonants by single letters. The Mayidavolu and Hirahadagalli grants of Śivaskandavarman, on the other hand, express them, in many cases, by two letters. The Ikṣvākū records are in Prākṛit, whereas the seals of Śivaskandavarman's Prākṛit grants have been written in Sanskrit. According to Dr. Sircar these linguistic differences indicate that the Ikṣvākū records are earlier than those of the early Pallavas (D. C. Sircar, *Successors of the Sātavāhanas in Lower Deccan*, p. 166). Though there is no doubt that the Ikṣvākū ruled earlier than the Pallavas, these linguistic differences do not necessarily mean any separation in time. For example, the record which we discuss and another Nāgārjunakonda inscription, which are definitely earlier than the Pallava records, are written in nearly purely Sanskrit (*I.A.*, 1956-57, pp. 36 and 38; Pls. LVIII and LIX), and express compound consonants by two letters (*I.A.*, 1956-57; Pl. LVIII, *spa* in l. 1; *tra* in ll. 1 and 4; *kṣvū* in ll. 5 and 8; *svā* in l. 10, etc.).

² *I.A.*, 1956-57, Pl. LVIII, ll. 4 and 8.

³ The decimal figure is quite clear, but the unit figure can be read as six or eight.

⁴ *I.A.*, 1957-58, p. 54. As the two epigraphs in question, which are published in two different numbers of *I.A.—A Review*, seem to have the same content, the present author is not sure whether these two notices refer to two different or to one and the same inscription.

refer to the same event, and in that case, the date of our record should also be read as 16.

Thus the epigraphs in question reveal the existence of a new member of the Ikṣvākū family, called Virapurusaḍatta or Purusaḍatta. He was probably a brother of Vāsiṣṭhīputra Rudrapurusaḍatta, referred to in another Nāgārjunakonda record.¹

Another important piece of information disclosed by our record is that some members of the maternal family of Caṁtamūla (II) were Mahātalavaras, and those of his father-in-law's family were also of the same rank. It is known also from few other epigraphs that the Ikṣvākūs had matrimonial relations with the Mahātalavaras.²

Our record states that Kupaṇasrī, the *Mahādevī* of Caṁtamūla (II), was the daughter of Mahātalavara Caṁdahāla (Candrahāra), the latter being the son of Mahātalavara Skandagopa (Skandagopa) of the Puṣyakotiya family.³ Caṁtamūla himself was the sister's son of another Mahātalavara (*itara-mahātalavara*), the latter being the son of Sesebamāgūraka. The son of Caṁtamūla (II) and Kupaṇasrī was, as has been stated above, Virapurusaḍatta (II). Prince Virapurusaḍatta (*Mahārājakumāra*) has been invested with the usual Ikṣvākū title of *Mahāsenāpati* and *Hāritīputra*. The use of the latter term indicates the popularity of the goddess Hāriti concerned in our period. He seems to have been a man of a religious bent of mind. For he erected the temple, referred to above, as the very embodiment of the victory of victories and of augmentation of longevity of king (Caṁtamūla II) and that of the fruit of the religious activities of the two sons (of Caṁtamūla).

The epigraph, under discussion, also gives a genealogy of the Ikṣvākū family. It refers to Vāsiṣṭhīputra Caṁtamūla (I) as one who had earned the fame of victory by his own prowess and who was the performer of such vedic sacrifices as *Agniṣṭoma*, *Vājapeya*, *Aśvamedha* and *Bahusuvarṇaka*.

¹ *I.A.*, 1955-56, p. 24. A record from Gurzala, which has close palaeographic similarity with that of the Ikṣvākū inscriptions, refers to the fourth year of the reign of Mahārāja Rulupuriṣadāta (i.e. Rulupurusaḍatta) (*Epigraphia Indica*, Vol. XXVI, pp. 123ff.). If the latter was really an Ikṣvākū ruler, he might have been identical with Rudrapurusaḍatta, a son of Caṁtamūla II.

² A sister of Caṁtamūla I was given in marriage to one Mahāsenāpati Mahātalavara Khamdasiri of the Pūkiya family (*E.I.*, Vol. XX, pp. 20-21). A daughter of the same king became the wife of Mahāsenāpati Mahātalavara Mahādaṇḍanāyaka Khamdaviśākhamṇaka of the Dhanaka house.

It appears that during the third and the fourth centuries A.D., many chiefs belonging to different families of Southern India used feudatory titles like *Mahātalavara*, *Mahādaṇḍanāyaka* and others. Probably they were descendants of provincial governors and administrators of the Maurya and the Sātavāhana empires. These chiefs were *de facto* and probably also *de jure* independent rulers. Dr. D. C. Sircar observes that the *Mahātalavaras* are mentioned in the early Jaina works along with eighteen 'Gaṇa-rājas' (see *Kalpasūtra*, ed. Jacobi, 6. 1. ll. 21-25). A Sanskrit commentary on the *Kalpasūtra*, called *Subodhikā*, explains the terms *Talavara* as *tuṣṭa-bhūpāla-pradatta-paṭṭabandha-bībhūṣita-rājasthānīya*. In the Punjab there is a subdivision of the Khetries (Kṣatriyas) called Talwar (*E.I.*, Vol. XX, p. 6, N.I.). Vogel suggests a connection of the word *Talavara* with Tamil *Talavāy* (general), *Talaiyari* (village watchman) or Kanarese *Talavara* or *Talavāra* (watchman, beadle). It seems from the evidences of the *Subodhikā* and these inscriptions that the *Mahātalavaras* were provincial governors or subordinate rulers (s.s. Id, p. 19).

³ A Nāgārjunakonda epigraph refers to the Pūkiya family (*E.I.*, Vol. XX, pp. 20-21). The Pūkiyas have been located by some writers in the Pungi district, comprising Nellore and adjacent area (*The Age of the Imperial Unity*, p. 224). An inscription, found in the Krishna district, mentions the *Mahātalavaras* of the Mūgiyas. It has been suggested that the Mūgiyas may be identical with the Pūkiyas (*Annual Report of South Indian Epigraphy*, 1926-27, p. 74). Can the Puṣyakotiyyas of our record and the Pūkiyas be identical?

He was also the giver of hundred thousand cows and hundred thousand ploughs. He is also said in some other Nāgārjunakonda inscriptions to have performed the same sacrifices.¹ These references indicate the popularity of the Brahmanical sacrifices in Andhradeśa in our period. The son of Cāntamūla (I) has been simply referred to as Mahārāja Mātharīputra Śrī Virapurūṣadatta (I). But the latter's son Śrī Ehavala Cāntamūla (II)² has been compared as a *Dharmavijayin* with such epic heroes as Sagara, Dilīpa, Ambarīṣa, and Yudhiṣṭhira, and is said to be as popular with all men as Rāma was.³ References to these epic heroes indicate the popularity of epic tales in Andhradeśa during third-fourth centuries A.D.

The above discussions reveal the importance of our record as a source of the dynastic history of the Ikṣvākūs and also as that of the socio-religious history of our period. The genealogies, given in this record, may be stated as follows in a tabular form:

Sesebamāgūraka	Cāntamūla (I)	}	Mahātalavara Skandagopa of the Puṣyakotīya family
Itara-Mahātalavara	daughter = Virapurūṣadatta		
			Chandrahāra
	Cāntamūla (II)	=	Kupaṇasrī
	Virapurūṣadatta (II)		

The text and its pure Sanskritized version are given below.

Transcription of the Text :

- L. 1 : Siddham || namo bhagavato Mahādevasya Puṣpabhaddrasvāminah (||*)
mahārājasya Vāsiṣṭhīputrasya
L. 2 : Śryehavala Cāntamūlasya samva 16 (or 18) gipa 3 diva 5 (||*)
Rājño Vāsiṣṭhīputrasya agniṣṭoḥma
L. 3 : Vājapeyāsvamedha bahusuvārṇṇaka yājinaḥ naikahiraṇya-kotīpra-
dātuḥ gośatasahasra halasatasahasra pradātu(h)
L. 4 : Svavīryarjjitavijayakīrtteh Ikṣvākūnam Śrī Cāntamūlasya pra-
pautreṇa mahārājasya Mātharīputrasya Ikṣvākūnām Śrī Vira-
purūṣadattasya
L. 5 : Pautreṇa mahārājasya Sagara Dilīpāmbarīṣa Yudhiṣṭhiratulya dhar-
mmavijayasya Ramasyeva sarvvajanābhīrāmasya Ikṣvākūnam
L. 6 : Śryihavala Cāntamūlasya putreṇa Puṣyakotīyānām mahātalavara-
sya Skandagopasya naptyaḥ mahātalavarasya

¹ Vāsiṣṭhīputra Cāntamūla I has been given the same epithets in some other Nāgārjunakonda records (*E.I.*, Vol. XX, p. 1ff.). In two places he is said to have performed also Agnihotra sacrifice. For a discussion of the nature of these sacrifices, see *Vedic Index* by Macdonald and Keith (Vol. I, p. 44 and Vol. II, p. 281). See also s.s. 1d, p. 342ff. References to *Gośatasahasra* and *halasatasahasra* remind us of certain Kṣātrapa records of Western India.

² The correct name of Cāntamūla II is Vāsiṣṭhīputra Ehuvala or Ehavala or Ehavala Cāntamūla II (*E.I.*, Vol. XX, p. 121; Vol. XXI, pp. 63ff.; *I.A.*, 1955-56, p. 241; *I.A.*, 1956-57, p. 36 and Pl. LVIII, l. 1; *I.A.*, 1957-58, pp. 6, 8 and 54), or Ihavala Cāntamūla II (see l. 6). An inscription probably refers to Cāntamūla (II) as Ehuvalasrī (*I.A.*, 1957-58, p. 54).

³ The epic heroes used to perform *dharmavijaya* by conquering the enemies but not taking their territories. Kālidāsa refers to Raghu as having deprived Mahendranātha of his glory but not of his territory (. . . *sa dharmavijayā nṛpaḥ Śrīyaṁ Mahendranāthasya jahāra, na tu medinīm, Rāghuvamśa*, canto IV).

- L. 7 : Chāṇḍahālasya duhituḥ Sesebamāgūrakadauhitrya itara mahātala-
varabhāgineyyaḥ rājñāḥ Śryehavala Chāṇṭamūlasya
L. 8 : Mahiṣyā mahādevyāḥ Kupaṇāśryāḥ puttrena mahārājakumāreṇa
mahāsenāpatinā Haritīputrena Ikṣvākūṇām
L. 9 : Śrī Virapurusaḍattena mahārājasya Mahādevyā gottrasya (vi)jayave-
jyaike āyurvadhana dvayorapicha śataputrayo
L. 10 : Dharmaphalaṁ bhagavato Puspabhadrasvāmināḥ devakulaṁ kārī-
taṁ dhvajastambascha pratiṣṭhapitaḥ gramaśchapradākṣedaṁ ak-
ṣayanivī
L. 11 : Dattaḥ (||*) (some meaningless scribblings).

Sanskritized Version of the Text :

- L. 1 Siddham || namo bhagavate mahādevāya Puspabhadrasvāmine (I)
Mahārājasya Vāsiṣṭhīputrasya
L. 2 Śryehavala-Chāṇṭamūlasya saṁva(t) 16 (or 18), grīṣma pakṣe 3,
divasa 5 (II) Rājño Vāsiṣṭhīputrasya agniṣṭoma—
L. 3 Vājapeyāśvamedha-bahusuvarṇṇakā-yājinaḥ naikahiraṇyakotīpra-
dātuḥ gośatasahasra-halaśatasahasrapradātuḥ
L. 4 Svavīryyārjītavijayakīrtteḥ Ikṣvākūṇām Śrī Chāṇṭamūlasya
prapautreṇa, mahārājasya Mātharīputrasya Ikṣvākūṇām Śrī-
Virapurusaḍattasya
L. 5 Pautreṇa, mahārājasya Sagara-Dilīpāmbarīṣa-Yudhisthiratulya-dha-
rmavijayasya Rāmasyeva sarvvajanābhirāmasya Ikṣvākūṇām
L. 6 Śryehavala-Chāṇṭamūlasya putreṇa, Pusaḥkotīyānām mahātala-
varasya Skandagopasya naptryāḥ mahātala-varasya
L. 7 Chāṇḍahālasya duhituḥ Sesebamāgūraka-dauhitryasya itara-mahāta-
lavara-bhāgineyasya rājñāḥ Śryehavala-Chāṇṭamūlasya
L. 8 Mahiṣyā mahādevyāḥ Kupaṇāśryāḥ putreṇa, mahārājakumāreṇa
mahāsenāpatinā Haritīputreṇa Ikṣvākūṇām
L. 9 Śrī-Virapurusaḍattena mahārājasya mahādevyā-gotrasya vijayavai-
jayikaṁ āyurvarddhanam dvayorapicha satputrayoḥ²
L. 10 Dharmaphalaṁ bhagavato Puspabhadrasvāmināḥ devakulaṁ kārī-
taṁ, dhvajastambascha pratiṣṭhāpitaḥ, grāmaschāpradakedaṁ
akṣayanivī³
L. 11 Dattaḥ (I)

¹ Several early Indian inscriptions do not mention months, but speak only of seasons and fortnights. Sometimes the fifth fortnight of a season is mentioned. In that case it should be taken for granted that one season consisted of more than four fortnights (i.e. two months).

² The two sons were most probably Rudrapurusaḍatta and Virapurusaḍatta (II).

³ For correct interpretation of the term *akṣayanivī*, see Dr. R. G. Basak's article in *Asutosh Mukherjee Silver Jubilee Volume*, *Orientalia* Section, Pt. II.

YÚSUF 'ALÍ KHÁN, AUTHOR OF THE *TÁRÍKH-I-BANGÁLA-I-MAHÁBATJANGÍ*

By ABDUS SUBHAN KHAN

The medieval period of the history of Bengal cannot be said to be very fortunate in having Persian chronicles that could record the achievements of the independent rulers whose language was Persian. The small number of historical works written in Persian on the Muslim period of Bengal, especially the pre-Mughul era, usually lack in factual completeness and chronological perfection. Among such histories is one that concerns the life and achievements of Nawáb 'Alí Vardí Khán (d. 1169/1756). It is entitled variously—*Aḥwál-i-'Alí Vardí Khán*¹ or *Aḥwál-i-Mahábatjang*² or *Kitáb-i-Tawárikh Náma*³ or *Tárikh-i-Mahábatjang*,⁴ but more comprehensive is *Tárikh-i-Bangála-i-Mahábatjangí*, this manuscript being in possession of the British Museum. Though no manuscript copy of the work contains the author's name, it is unanimously believed to be the work of Yúsuf 'Alí Khán—a name that has not been accorded its due prominence among the distinguished historians of the Bengal of the later Mughul period.

The authority for ascribing to him the *Tárikh-i-Bangála-i-Mahábatjangí*, however, is Rev. J. H. Hindley,⁵ a scholar of early nineteenth century, who compiled a list of Persian manuscripts. He describes Yúsuf 'Alí Khán as an 'intimate friend of Mahábatjang'. In spite of the omission of the author's name from the work, it is not at all difficult to confirm the attribution. In fact, no scholar who has written on the period which the work deals with has ever brought the authorship of Yúsuf 'Alí into question. Sir Jadunath Sarkar,⁶ Dr. K. K. Datta⁷ and others regard the opinion of Rev. Hindley as perfectly correct. Ghulám Husain, the author of the *Siyar-ul-Muta'khkhirin*, refers to a contemporary writer named Yúsuf 'Alí Khán as his authority in the description of the sufferings of Nawáb 'Alí Vardí Khán's troops in the course of their journey from Burdwan to Katwa. This Yúsuf 'Alí Khán⁸ is none but the author of the *Tárikh-i-Bangála-i-Mahábatjangí*. On other occasions, too, Ghulám Husain appears to have been greatly influenced by the accounts given by Yúsuf 'Alí. This ascription, therefore, of the authorship of the work is beyond all shades of doubt. We can now proceed with more confidence in constructing his biography.

That the author was married to a daughter of Nawáb Sarfaráz Khán has never been disputed. By her he got a daughter named Jariat-uz-Zuhra⁹ who was given in marriage to the famous 'Alí Ibráhim Khán¹⁰ of

¹ The Asiatic Society MS. Ivanow 205.

² The Salar Jang MS.

³ The Patna University MS.

⁴ The Raza Library MS. (Rampur).

⁵ Charles Rieu: *Pers. Cat.*, Vol. II, p. 806; see also C. A. Storey: *Persian Literature: A Bibliographical Survey*, pp. 139-40, 717.

⁶ *Bengal Nawabs*, p. 79.

⁷ *Alivardi and His Times*, pp. 277-78.

⁸ Arthur Hugh writes 'Nawab Yusuf Ali Khan' (see *Bengal: Past and Present*, Vol. LXXVII, Part I, p. 5). No instance of Yusuf 'Alí's name being prefixed by 'Nawáb' has been found in any other work.

⁹ See *IHRC, Proceedings*, Vol. XXII, 1945, p. 45, f.n. 4.

¹⁰ For his biography, see Storey, p. 277.

Banaras. Yúsuf 'Alí's father, Ghulám 'Alí Khán, was a Diwán-i-Khálisa of Patna. He was a trusted general of 'Alívardí and one of the distinguished nobles of his age.¹ He was also an Arz Begí to 'Alívardí.² Ghulám Husain says that he was a confidant and boon companion of the Nawáb. He was excellent in manner and sober in temperament. He held an envious position among 'Alívardí's comrades, enjoying confidence and goodwill of the high and the low. Ghulám 'Alí was often entrusted with delicate and confidential matters. It was only through his good offices that 'Alívardí could get himself convinced of the loyalty of his wavering and ambitious Afghan generals who were to have defected from the Nawáb's party in the face of the Marhatta menace. Ghulám Husain remarks on this: 'And truly to hear such expressions at so critical a moment from a powerful and zealous friend never fails to inspire fresh courage and to afford an additional degree of daringness.'³ Ghulám 'Alí Khán again rose to the occasion when he accompanied his master to Medinipur to repel the Marhattas in Orissa after Haider 'Alí Khán,⁴ commander of the Nawáb's light infantry, refused to do so. Thus we find that Yúsuf 'Alí's father had a very distinguished career. Ghulám 'Alí died at Allahabad in the haveli of Ni'matulláh on the 11th of Rajab 1177.⁵ His death occurred when his son became entangled in the torrent of life. The son was ill and unemployed, and was under constant threat of Nawáb Mir Ja'far, consequent upon his fidelity to Mir Qásim 'Alí Khán, the former Nawáb.

The instance of 'like father, like son' is very rarely found in history. But the life of our author affords us with such an example. Like his father, he enjoyed enormous respect and rank. Being a relation of the Nawáb he was from his youth closely associated with him. He possessed the dual gifts of being a courtier and at the same time a soldier. But what made him distinguished in history were his writings about what he saw and felt. It is due to his chronicles that we are capable of knowing the history of 'Alívardí and his times in detail. Yúsuf 'Alí was included in the Nawáb's party that made a retreat from Burdwan after fighting first few clashes with the Marhatta freebooters. He happened to be in that skirmish as he had gone to receive his father who was on the way. He says :

راقم حروف دران معرکه برسم استقبال جناب والد مرحوم رفقه همراه ركاب آنجناب بود

He proceeds by saying بخاطر دارد (i.e. it comes to the memory). This shows that he was comparatively much younger when he witnessed the retreat that occurred in the spring of 1742. The vividness with which he delineates the hazards suffered by 'Alívardí's army during its retreat from Burdwan to Katwa makes the reader feel as if the whole scene is presented in a photograph. The account is so authentic and authoritative that later historians like Ghulám Husain have made extensive use of it in their description to the extent of taking some sentences thereof verbatim. Yúsuf 'Alí participated in other campaigns of 'Alívardí to Medinipur and Orissa in 1749. Later when Mir Qásim became Nawáb, Yúsuf 'Alí attached himself to his court and came under his benign patronage. He faithfully repaid his debt of gratitude to that Nawáb by retaining to the last his staunch fidelity to him.

¹ Cf. *Alivardi and His Times*, p. 277.

² *Bengal: Past and Present*, Vol. LXXVII, Part I, p. 5. Arz Begí is a person who presents all petitions, either written or by word of mouth.

³ *Siyar*, tr., p. 387. Ghulám Husain's use of the words amply demonstrates the depth of Ghulám 'Alí's friendship with 'Alívardí.

⁴ See *Alivardi and His Times*, p. 106.

⁵ *IHRC, Proceedings*, Vol. XXII, 1945, p. 47, f.n. 9.

His obedience to his master is further proved by the tribulations he underwent in the teeth of dangerous threats from Mír Ja'far. When Mír Qásim was sent into exile in 1763, Yúsuf 'Alí followed him, but his sickness made it impossible for him to accompany his banished benefactor further to Oudh and Bundelkhund. He, however, stayed behind at Allahabad. It is not known when Yúsuf 'Alí died, but the year 1195/1781 is given as the probable date.

In his biography on 'Alívardí, the author makes some interesting references. On fol. 20a-20b of the Asiatic Society copy, we find the author recalling the treacherous situation he faced while in the Nawáb's party in its journey from Burdwan to Katwa. Another more detailed reference is found on fol. 25a-25b where he modestly presents his apology for not having substantiated his accounts with relevant dates. The reason he enumerates for that defect are the lapse of time, the distraction caused by many kinds of calamities and the indifference of Nawáb Mír Ja'far Khán. Then he speaks briefly how he wrote the book.

Besides the biography of 'Alívardí, Yúsuf 'Alí Khán composed other equally authentic works. They are: *Hadíqat-u's-Şafá*,¹ a *Tadhkira* of Persian poets and the *Majmú'a-i-Yúsufí* noted for its rarity. Some notices of these are given below :

(1) *Hadíqat-u's-Şafá* :

It is a large compendium of general history from the very beginning to 1173/1759. The work is divided into an introduction, three volumes and a conclusion. Each volume is subdivided into several *rauḍahs* or meadows and each *rauḍah* into several *dauḥahs* or trees and each *dauḥah* into several *ghusns* or branches. The preface of the work refers to some literary activities of the author and his efforts in the course of writing the history. The preface reveals that the author had collected the materials for the work during the time of 'Alívardí Khán. Then he was faced with many problems (which he does not want to mention) that stood in the way of his beginning the actual composition.² It was only after 'Alívardí's death that occurred in 1169/1756 that it was possible for him to take up his work. In short he commenced it in 1170/1756.³ The author refers to the year 1173 as the current year at the time of writing.⁴ He complains of the lack of help of others in the writing of the work. At one stage he was so disappointed that he thought of abandoning the work when only a fragment of it was prepared. But the timely persuasion of 'Alívardí who was much impressed by that small portion of writing filled the author with hope and courage which later on culminated in the completion of the history.

¹ For manuscript copies of this work, see Storey, pp. 139-40 (No. 167). The Bodleian Library's copy bears the author's autograph. See Sachau: *Pers. Cat. Bod. Lib.* (pp. 63-65) for the most detailed description of the work.

² See Bodleian Library copy, fol. 2a, ll. 24-26 :

بنابر بعض موانع كه تفصيل آن لائق ابن مقام نيست در حجاب تعويق تا بعد فوت
ميرور در سنه هزار و صد و هشت و نه ... الخ *

(Sachau, p. 59).

³ *Ibid.*, fol. 26, l. 4 :

در سنه هزار و صد و هفتاد شروع آن نمود *

⁴ Sachau (p. 59) :

تا حال كه سنه يك هزار و يكصد و هفتاد و سه هجريت *

Though concise and comprehensive, the work is very remarkable for its extremely accurate chronology and its particular notices of the learned persons of the single epochs. The appendix of the *khátima* is the most interesting part of the work, as it contains brief accounts of contemporary poets who were intimately connected with the author. In fact, the *Hadíqat-u's-Safá* is sufficient to make its author reckoned among the first rank of writers of general histories in Persian.

(2) *Tadhkira* of Persian poets :

This *memoir*¹ of Persian poets is sometimes taken as a part of the previous work. But usually it is considered to be a separate work of the author. It was, however, completed at Murshidabad in 1184/1770-1. It comprises short alphabetically arranged notices of about 300 poets of Persian from the very beginning of poetry to the author's time. It contains an appendix relating to twenty contemporary poets not included in the *Majma'u'n Nafá'is* of Sirájuddín 'Alí Khán, better known as Arzú.

(3) *Majmú'a-i-Yúsufi* :

This work² was brought to light by Prof. Syed Hasan Askari of Patna College. This is a rare Persian manuscript of 336ff., written in beautiful Naskh and Nasta'liq. Besides containing some selected pieces from the writings of eminent literary figures, it deals with many topics of immense historical value. Its most important part is the diary of the itinerary of the compiler who accompanied Mír Qásim in his journey from Murshidabad to Patna. The author gives an eyewitness account of the main political events that happened in Eastern India between 1761 and 1767. There is given a very authentic description of the post-Karnal affairs during the stay of Nádir Sháh in India. It is from this compendium that we are able to know how Yúsuf 'Alí Khán became a victim of the wrath of Nawáb Mír Ja'far Khán and how he secured immunity through his influential friends, Dr. Fullerton and Mír Muḥammad 'Alí. The death of Mír Ja'far on February 6, 1765, gave the author security from further harassment. In fact, the diary is of unique importance not only for its chronology but also for a few new facts which one finds in it.

¹ For references, see *Cat. Pers. Bod. Lib.*, No. 118; *Cat. Oudh Mass.*, No. 62, where Sprenger gives the list and epitome of the twenty biographies in the appendix.

² See *IHRC, Proceedings*, Vol. XXII, 1945, pp. 45-48; cf. *Bengal Nawabs*, p. 80.

ON THE WORKING OF VILLAGE ASSEMBLIES, ECONOMIC GUILDS,
RELIGIOUS CONGREGATIONS AND OTHER ASSEMBLIES
DURING THE GUPTA PERIOD

By U. N. GHOSHAL

THE LATE SMṚITI LAW OF GROUPS

Among the titles of law dealt with in the metrical *Smṛitis* from the *Manu-Smṛiti* downwards, there is one called 'violation of compacts' (*samvid-vyatikrama*) or else 'non-performance of agreement' (*samayasyānapākarma*). This branch of law relates to what are called groups and corporations (*samūhas* and *vargas*). The lists in the later *Smṛitis* follow closely those of the earlier ones. The group consists, according to Nārada, of the units *pāshaṇḍa*, *naigama*, *śrenī*, *pūga*, *vrāta*, *gaṇa* and the rest; and according to Bṛihaspati, of those called *kula*, *śrenī*, *gaṇa* and the inhabitants of towns and fortified posts. Kātyāyana, quoting Bṛihaspati, defines *varga* as comprising the units *gaṇa*, *pāshaṇḍa*, *pūga*, *vrāta*, *śrenī* and all the rest constituting the *samūha*.¹ In the present context we are concerned with the *grāma*, the *pāshaṇḍa*, the *śrenī* (or *pūga*) and the *naigama* units. In the above *grāma*, of course, means the village, and *pāshaṇḍa* is the generic term for heretics at least from the time of Manu and Yājñavalkya, while *śrenī* (Pāli *seṇi*) is a familiar term for the guilds of artisans and traders from the time of the early Buddhist literature onwards. Kātyāyana, however, in the context from which we have quoted above uses the term *pūga* for a group of merchants and so forth, while he leaves the term *śrenī* unexplained. Kātyāyana likewise defines *naigama* as a group of various inhabitants of the same town differing slightly from *Amara-kośa* (II, 9.38) which takes it to be a synonym for a merchant. With this may be compared the double significance of *nigama* as a small town and a market as far back as in the early Pāli literature.²

Abbreviations :

- B.S. = *Bṛihat-saṁhitā*, ed. V. Subrahmanya Sastri and M. Ramakrishna Bhat, 2 Vols., Bangalore, 1947.
Bṛi. = *Bṛihaspatismṛiti* (reconstructed), ed. K. V. Rangaswami Aiyangar, Baroda, 1941.
Kāt. = *Kātyāyanasmṛitisāroddhāra*, text, translation, etc., by P. V. Kane, 1933.
M. = *Manusmṛiti*.
M.A.S.I. = *Memoirs of the Archaeological Survey of India*.
Nār. = *Nārada-smṛiti*, ed. J. Jolly.
Yāj. = *Yājñavalkyasmṛiti*.
A.S.I.A.R. = *Annual Report of the Archaeological Survey of India*.

¹ Nār. X. 2 Bṛi. I. 17. 17, Kāt. v. 682. With the above may be compared M. VIII. 219-221 (*grāma*, *deśa* and *saṁgha*; alternatively, *deśa*, *jāti* and *samūha*), Yāj. II. 192 (*śrenī*, *nigama*, *pāshaṇḍi* and *gaṇa*).

² Kāt. vv. 678-79 (definitions of *nigama* and *pūga*). *Amara-kośa* II. 9. 78 (synonym of *naigama*). On *nigama* in Pāli literature see *P.T.S. Diet.* s.v. For different interpretations of the ambiguous terms *śrenī*, *nigama*, *pūga*, *vrāta* and *gaṇa*, see Kane, *History of Dharmasāstra*, Vol. II, 68-69, Vol. III, 159, 487-88.

The late *Smṛiti* law of groups may be described under the following heads :

- (1) Constitution of groups.
- (2) Compacts of groups.
- (3) Rights and duties of the individual members.

CONSTITUTION OF GROUPS

From a text of Brihaspati we learn that the family (*kula*), the guild (*śrenī*) and the *gaṇa* were headed by high executive officers (*adhyakshas* or *mukhyas*) who were further assisted in the case of the villages, the guilds and the *gaṇas* by committees of two, three or five persons called advisers for the public good (*samūha-hitavādins*) as well as advisers for public business (*kārya-chintakas*). The *adhyakshas* were authorized by law to punish wrongdoers by reprimand and censure as well as by excommunication. Their decisions in the course of their distinctive duties, whether by way of rewards or of punishments, were required to be approved by the king, 'for such powers were regarded by the sages as delegated to them'. The opinion of the advisers was to be followed by the villagers, the guilds, the *gaṇas*, and the like. Disputes between the chief executive officers (*mukhyas*) and the groups (*samūhas*) were to be settled by the king.³

COMPACTS OF GROUPS

Explaining the purpose of the compacts, Nārada observes that the king should approve of all their distinctive conventions (*dharma*s), duties (*karma*s), modes of attendance (*upasthānavidhi*) and of livelihood (*vrityu-pādāna*). According to Brihaspati, the compacts were to be formed at a time of public disorder and for the purposes of pious and charitable works. The first type is illustrated by compacts for collective prevention of danger from robbers and irregular troops. The second type is defined as a written agreement for repair of assembly-houses (*sabhās*), sheds for distribution of drinking water to travellers, temples, tanks and gardens, for helping performance of sacraments by poor and helpless persons, for the performance of sacrifices and 'for prevention of famine-stricken groups of families from coming' (alternatively, 'for starting water-courses and stemming the same').⁴ To the above we have to add that the late *Smṛitis* know a class of documents called *sthītipatras* or *samvitpatras* meaning 'a deed of convention which is made by the inhabitants of a village or city or the members of a corporation or guild by mutual agreement for settling their conventions'.⁵ The legal effect of the compact is defined by Nārada and Brihaspati after Manu and Yājñavalkya in the same context. The conventions of the *pāśhaṇḍas*, the *naigamas*, the *śrenīs*, the *pūgas*, and so forth, for the purposes above mentioned, we are told by Nārada, are to be enforced by the king, exceptions being made in the case of what is adverse to the king's interest and is disapproved by the people and is harmful to the public good. What is more, the

³ Bṛi. I. 17. 8-10, *ibid.* 17-18, *ibid.*, 20 (*adhyakshas*, *kāryachintakas* and *samūha-hitavādins*). The translation 'for such powers were regarded by the sages as delegated to them' is after Kane, *op. cit.* Vol. III.

⁴ Nār. X. 3, Bṛi. I. 17. 5-6; 11-12. The translation of the last portion in Brihaspati's text 'for prevention of famine-stricken groups, etc.' is after Kane III. 156 n. and 157. For concrete illustrations of conventions or compacts of groups in the later *Smṛiti* commentaries and digests see Kane: *op. cit.* Vol. III, 486-88.

⁵ Bṛi. I. 6. 10 Vyāsa, Kāt. v. 254. The translation of *sthītipatra* (*samvitpatra*) is after Kane, *op. cit.* Vol. III, 311.

king is required to maintain the usages, even though they are blamable and are laid down by authorities other than the Vedas, and are in operation. According to Bṛihaspati a member is bound to perform his share of the convention, if he is capable of the same; otherwise he would be liable to the extreme punishment of confiscation of his whole property and banishment. The members of the groups, according to Kātyāyana, were bound to follow their respective conventions or rules in all their acts, subject to their obligation of performing their individual duties (as laid down in the scriptures) and to obey the king's order not conflicting with the same.⁶

RIGHTS AND DUTIES OF THE INDIVIDUAL MEMBERS

The law of the later *Smṛitis* on this point carries further what is laid down in the earlier ones. Nārada prohibits mutual combination and unlawful wearing of arms as well as mutual conflicts among the groups, while he imposes a specially severe penalty upon those creating dissensions among the *gaṇas*. This last is justified on the ground that otherwise there would arise a grave danger like a disease which is neglected. One who creates dissensions or is indifferent in the matter of performing his share of the compact, says Bṛihaspati, is liable to a fine in gold coins, while the extreme penalty of banishment is laid down for one who injures the common interest or insults those who are learned in the Vedas. According to Kātyāyana, one who opposes what is reasonable or persistently interrupts a speaker or speaks what is absurd is liable to a fine. One committing a heinous crime or causing a split or destroying the property of the group is to be proclaimed before the king and destroyed.⁷ By contrast those collectively oppressing a member out of spite are to be restrained by the king, and they are to be punished if they persist in their misbehaviour. All members, we are further told, have an equal share in whatever is acquired by the committee of advisers or is saved by them and whatever they acquire through the king's favour as well as whatever debts are incurred by them for the purpose of the group.⁸

HISTORICAL EXAMPLES—EVIDENCE OF THE CLAY SEALS

The excavations of historical sites at Basarh (ancient Vaiśālī), Bhita (near Allahabad), and Nalanda have resulted in the discovery of certain distinctive types of clay seals and sealings of the Gupta period, which deal with groups. These are found along with the seals and seal-impressions of kings and their officials, and those of private individuals as well. The clay seals have grooves in their back-side frequently with impressions of the strings used for binding the attached documents. Let us begin with the Basarh seals. In a subterranean chamber on this site Dr. T. Bloch recovered nearly 720 clay seals with legends in an Eastern variety of the

⁶ Nār. X. 3-4, 7; Bṛi. I. 17. 13-14; Kāt. vv. 668-70. With these compare M. VIII. 219-20 and Yāj. II. 187.

⁷ Nār X. 4-6; Bṛi. I. 17. 14-16; Kāt. vv. 671-72.

⁸ Bṛi. I. 17. 25; Kāt. v. 677. To the above Bṛi., *ibid.*, 23 adds that whatever is gained by the groups belongs equally to all and should be divided among them every month or six months according to their shares. Kāt. (vv. 675-76) further adds that all who have subsequently joined the *gaṇa*, the *śreṇī* and the *varga* share equally in the property as well as debts of the group, while one inside the group shares in the food, the partible articles, the charities and the religious acts of the group. From the texts quoted above we can form some idea of the sources of income and expenditure of the groups, the former constituting the *gaṇa*'s property which is protected by a clause of the *Smṛiti* law.

Gupta script belonging to the fourth and fifth centuries after Christ. Among these there were three specimens of seals bearing the legend *śreshṭhī-kulika-nigama*, while no less than 274 specimens have the legend *śreshṭhī-sārthavāha-kulika-nigama* (or *°nigamas*). The seals of the former class were combined with other broken and illegible seals. Those of the latter category were combined most often with the seals of private individuals and in one exceptional specimen with that of an unnamed high official called the *Kumārā-mātya*. In other specimens these are joined with religious legends.

Compared with the evidence of the seals of Basarh that of the Bhita seals and sealings is of slight importance. On the site of this ancient city Sir John Marshall discovered only three sealings with the names of villages and one with the legend *nigama* in Gupta characters. With the other types recovered from the same centre we have here no concern.

More important is the evidence of the seals on the famous site of Nalanda, which have been deciphered and explained by Dr. Hirananda Sastri. We have to consider here, in particular, two types of these seals, namely those of the congregation of Buddhist monks said to be residing in 'the Great Monastery' or other monasteries of Nalanda and the seals of named villages. In the first group as many as 690 out of 775 were found in a single chamber of a particular monastery. The sealings of these specimens are often combined with those of distinct villages. The second group is represented by a die of a named village and the sealings of a few gift-villages of Brāhmaṇas (*agrahāras*). A unique group consists of sealings of what are called *grāma*-(var. *grāmakīya*) *jānapadas*, as many as thirteen villages under this category being mentioned by name. In two specimens the sealings are those of the *grāma-jānapada* attached to Nalanda and the *jānapada* of the monastery attached to Nalanda.⁹

Let us begin by attempting an explanation of the generic terms *nigama* (and its varieties) and *grāma-jānapada* (with variants) mentioned in the above context. The *nigama* (or *nigamas*) of the *śreshṭhīs* and the *kulikas* as well as of the *śreshṭhīs*, *sārthavāhas* and *kulikas* have been translated by Dr. Bloch as 'the corporation of bankers and merchants' and that of 'bankers, traders and merchants' respectively. Now *nigama* strictly means 'a small town' or 'a market town' (above), while the *śreshṭhīs*, *sārthavāhas* and *kulikas* are better rendered respectively as guild-president, caravan-leader and artisan. May the compound of these titles mean the mercantile and industrial townships inhabited by these types of residents? As regards the term *grāma-jānapada* of the Nalanda collection of clay seals, it has been translated by Dr. Sastri somewhat carelessly both as 'the village community' and as 'the municipal board'. The clue to the correct rendering of this term may perhaps be found in the parallel legends *grāma-traividyasya* and *agrahāre śrīmat-traividyasya* (along with the name of the village or the *agrahara* concerned) in other categories of the Nalanda seals. This would naturally refer to an individual learned *Brahmaṇa* having his residence in the village mentioned by name. On this analogy may the compound *grāma-jānapada* refer to the *jānapada* belonging to his particular village? This fits in with the description of *jānapada* as belonging to the *vihāra* of a particular village 'attached to' (*prativaddha*) the illustrious Nalanda (*ante*). As for the term *jānapada*, its etymological significance is that of the resident of a *jānapada* or 'the rural area'. It is well known how the technical

⁹ For complete accounts of the above see *A.S.I.A.R.*, 1903-04, *Excavations at Basarh* by T. Bloch, p. 101 and Plates; *ibid.*, 1910-11, *Excavations at Bhita* by Sir John Marshall, pp. 56ff. and Plates; *M.A.S.I.*, No. 66, *Nalanda and its Epigraphic Material* by Hirananda Sastri, pp. 36ff.

significance of a representative assembly of the countryside as distinguished from that of the city (*paura*) which was given to the term by the late Dr. K. P. Jayaswal has been found to be untenable. May it mean in the present context somewhat like 'a country-squire' or 'a gentleman higher in rank than the ordinary villager'? In any case the explanation we have offered above as referring to an individual rules out the *grāma-jānapada* seals from the category of groups with which we are dealing in the present place.

We shall now attempt to interpret the significance of the clay seals more particularly in the light of the *Smṛiti* law of groups above mentioned. We have first to observe that the documents attached to the seals of the *nigamas* at Basarh as well as the monastic seals at Nalanda were evidently held to be sufficiently important for their preservation in a separate chamber which was used as the registration office of the local government, or else as the record room of the monastic establishment. This is in the spirit of the *Smṛiti* law requiring the compacts or conventions of groups to be made under an oath or put down in writing.¹⁰ The documents belonging to the congregation of monks at Nalanda were evidently regarded as binding on the parties in accordance with the *Smṛiti* rule above mentioned giving the force of law to the conventions of heretics. In the second place it is evident that the documents executed by the single villages (Basarh, Bhita and Nalanda) were prepared for public purposes. In the light of the *Smṛiti* law aforesaid these might be supposed to deal *inter alia* with the working of the village constitution as well as mutual combinations for self-defence, and for performance of pious and charitable works. The villages which are in some cases specifically mentioned as being attached to Nalanda were probably included in the list of those which, as we know from other sources, were endowed by former kings and princes for the maintenance of the great monastic establishment. The technical designation of all documents of this class would be *sthitipatras* or *samvitpatras* as defined above. In the third place the documents made by the local guild (Bhita) and by the local industrial and trading groups in association with individuals (Basarh) were probably executed in the course of their ordinary business transactions. By way of exception, the document jointly drawn up by the local guild and the office of the *kumārāmatya* (Basarh) may have reference to some official transaction of the former body.¹¹ The various religious legends attached to the seals of the guilds would tend to emphasize the binding character of the agreements or compacts.¹² Fourthly and lastly, it is probable that the documents jointly executed by the great Buddhist monastery or the other monasteries at Nalanda and single villages related to such purposes as payment of dues by the endowed villages to the Nalanda

¹⁰ See M. VIII. 219 Bṛi. I. 17. 12.

¹¹ Basing his argument on the fact that generally two or even more of the seals of private individuals are found in combination with each other or with the seal of the guild of bankers, etc., Bloch (*op. cit.*, p. 104) suggests that 'something like a modern Chamber of Commerce existed at some big trading centre in Upper India at that time', and that the private individuals were members of the same. This interpretation seems to be far-fetched and improbable. The probable explanation seems to be that the seals or sealings are records of ordinary business transactions between the individuals and between them and the larger groups. Bloch's definite conclusion in the same context that 'most of the persons to whom the seals belonged carried on business transactions with the royal family of Vaiśālī' seems to be equally improbable. We would rather suggest that the documents to which the seals were attached were kept for preservation in the registration office of the local government.

¹² Under this head we would include the specimens with the colourless legend *dharmo rakshati rakshitah* added to the legend *freṇī-sārthavāha-kulika-nigama* (Bloch, *op. cit.*, pp. 105 and 113). Bloch's interpretation that the former expression was the proper name of the person who was a member of that guild is extremely improbable.

establishment. We may refer in this connection to the somewhat late evidence of the Chinese Buddhist pilgrim I-Tsing about the collection of the share of the agricultural produce by the *saṃgha* from the tenants cultivating their lands. The *saṃgha*, we are told, provided the fields and the bulls and received in return normally one-sixth share of the produce.¹³

HISTORICAL EXAMPLES—EVIDENCE OF THE INSCRIPTIONS

The *Smṛiti* law unfortunately throws little or no light upon the purely economic functions of the guilds. The branch of law relating to deposits (*nikshepa*) relates to articles given as a rule for the purpose of safe custody, while that relating to pledges (*ādhi*) is concerned with articles given by way of security for a loan. The omission is supplied by one important historical inscription of the Gupta period, namely the Indore copperplate inscription of the Emperor Skanda-gupta.¹⁴ This is a record of the endowment (perpetual gift) of a sum of money by a Brāhmaṇa donor to the local guild of oilmen for the purpose of (daily?) provision of a fixed quantity of oil for a Sun-temple. No doubt, the guild invested the sum in its own or other business for meeting the necessary expense out of the resulting income. The Gupta record is in line with a number of historical inscriptions of the earlier period recording endowments by princes and private individuals in favour of guilds for regular performance of acts of piety or charity.¹⁵ The above illustrates the function of the guilds in the capacity of bankers receiving private endowments for pious and charitable trusts.

¹³ *Record of the Buddhist Religion as Practised in India and the Malay Archipelago* by I-Tsing, by J. A. Takakusu, p. 61.

¹⁴ Flect, *S.I.I.*, pp. 70ff.

¹⁵ *E.I.*, XXI, pp. 60ff. Lüders' *List of Northern Inscriptions*, Nos. 133, 1162, 1165.

THE STONE INSCRIPTION OF KING SAÑJAYA (CANGGAL
INSCRIPTION), 654 ŚAKA

By HIMANSU BHUSAN SARKAR

The Canggal inscription was edited by Prof. Kern as early as 1885, but due to various reasons it has been found necessary to re-edit the inscription once again. Apart from the improved reading of certain verses of this inscription by Dr. B. C. Chhabra in an earlier issue of this *Journal* (*JASBL*, I, 1935), it has appeared to me, while preparing a work on the Sanskrit and old Javanese inscriptions of Java, that certain *ślokas* of this inscription have not been properly understood. The *kuñjarakuñjadēśa* of this inscription, for instance, has beguiled many Indian and European scholars for the last 75 years regarding its geography. Its location has been variously sought for in South India and more recently in Central Java. The romance of this *kuñjarakuñja* will, I hope, finally disappear after my interpretation of the relevant *ślokas*. I also believe that the relationship between King Sañjaya and Sanna (or Sannāha), upon which so many theories were built up in the past, will now be put on firmer foundation after my new translation and interpretation of facts. Other points have been noted in proper places. Some particulars are now given below to serve as an introduction to the study of this important inscription.

The Canggal inscription is the earliest dated record found in Java.¹ It was discovered about 75 years back near the temple-ruins on the *gunung* Wukir, below the hamlet of Canggal, in *dēśa* Kadiluwih of the district of Salam, in the Magelang division of South Kedu.² In 1879 it was deposited at the Batavia Museum where it has been numbered D.4. Five years later, on March 10, 1884, the news of its discovery was communicated to the Royal Academy of Amsterdam by Mr. Holle³ and, the very next year, Prof. Kern⁴ edited the inscription with elaborate notes, translation and an introduction. His article was accompanied by a heliotype of the record made after a paper-squeeze of the inscription. When his article was reproduced in the year 1917, Kern⁵ gave a new facsimile of the inscription, which was based upon a photo of the *Oudheid. Dienst*, taken in January, 1917. The latest facsimile has been published by Dr. Chhabra⁶ who has also suggested some improvements upon the reading of Dr. Kern.

The inscription is beautifully and legibly engraved on a stone measuring 110 cm. in height and 78 cm. in breadth. The decorative style of writing which we notice in the Jambu inscription is missing in the record under review, but its elegance of carving certainly represents a more advanced stage of palaeography. As there is a gap of more than 250 years between these inscriptions certainty cannot be reached on the question of considering this script of Central Java to be evolved from the West-Javanese script.

¹ There is a copperplate record in the Museum at Frankfurt relating to one Śrī Mahādewī. It has been said to date from 637 Śaka, but it is not known for certain if it is authentic and of Javanese origin. The provisional information of Bosch regarding the inscription has been published in *OV*, 1929, p. 156. See Krom: *Geschiedenis*, 2nd ed., p. 123 f.n.

² Vide *Rapp. Oudh. Dienst*, 1914, p. 262, No. 843.

³ *Verh. Meded. Kon. Ak. v. Wet. Afd. Lett.*, 3: 1 (1884), pp. 264ff.

⁴ *BKI*, 4: X (1885), pp. 125-28.

⁵ *VG*, VII, pp. 155ff.

⁶ See *JASBL*, I (1935), pp. 34-37.

In this respect, the Canggal inscription stands relatively closer to the Tuk Mas inscription and both of them agree in differing from the inscriptions of Pūrṇavarman in respect of such letters as *ra*, *ṇa*, etc. We cannot, however, say at the present moment if these variations have to be attributed to the history of script-evolution in Java. The Canggal inscription, at any rate, has several points of difference from the West-Javanese script, while there are many points of agreement with what Bühler calls the 'Middle Grantha' of Southern India. It is not unreasonable to presume with the data at our disposal that the script of Canggal may be independently derived from the Andhra-Kalīṅga region, introducing at the same time some local innovations into it. Prof. Kern¹ has noticed that the script of the Canggal inscription has also been used in the Hanh Khiei inscription of Cambodia and in the Uruvalli-copperplates of the Pallavas.

The inscription was incised on the occasion of founding a Śiva-*linga* in the Śaka year 654. By referring the date of this inscription to the Christian era it has been found out that this red-letter day fell on the 6th of October, A.D. 732, at one o'clock in the afternoon.² The record, after lavish praises of Śiva, Brahmā and Viṣṇu, describes the great island of Java. We are told that this land was ruled over by Sanna (or Sannāha) and that he was succeeded by Sañjaya, the reigning king. This Sañjaya was the founder of the Śiva-*linga* which has been mentioned in the opening verse of the inscription.³ It has been supposed that the father of Sañjaya might have been a Javanized Hindu, because the name Sanna-Sannāha is more or less unsanskritic.

The record is written in ornamental Sanskrit of not a very high order. It shows, however, that the poet was well versed in Sanskrit mythology. The following metres have been used: Vv. 1-2, 4-7, 12 in *śārdūla-vikrīḍita*; 3, 8 and 11 in *śragdharā*; 9 in *vasantatilaka* and 10 in *prthvī*.

Text

1. śākendre tigate⁴ śrutīndriyasairāṅgikṛte⁵ vatsare
vārendau dhavala trayodaśitithau⁶ bhadrottare kārṭtike
2. lagne kumbhamaye sthiraṅśavidite⁷ prātiṣṭhipatparvvate
līṅgaṃ lakṣaṇalakṣitannarapatiśrīsañjayaśśāntaye || 1
3. gaṅgottuṅgatarāṅgarāñjitajātāmaulīnducūdāmaṇi-
rbhāsvatbhūti⁸vibhūtidehavikasannāgendrahāradyutiḥ⁹
4. śrīmatṣvāñjalikośakomalakarairdevaistu ya stūyate
sa śreyo bhavatām bhavo bhavatamassūryyo dadātvadbhutam¹⁰ || 2

¹ VG, VII, pp. 123ff. For linguistic peculiarities of this inscription see *ibid.*, pp. 125-27.

² JASBL, I (1935), p. 35; Damais: BEFEO, 45 (1951), p. 60, and 46 (1952), p. 20, f.n. 2.

³ Regarding the historical importance of the data, see Stutterheim in TBG, 79 (1939), pp. 75ff., though all his views are not acceptable.

⁴ *vigate* would have given a better sense, but the reading seems to be impossible. Perhaps this is an error of the engraver.

⁵ Kern corrects as *anikikṛte*.

⁶ The correct form is °ṣi°, but metre requires a short syllable.

⁷ Kern read °ṅgā°. In the facsimile of Chhabra, we undoubtedly read as above. Chhabra's reading also tallies with ours.

⁸ This appears from Chhabra's facsimile. In Kern's facsimile we read *pāti* and not *paṁti*, such as Kern reads. Moreover, the word is *paṁkti* and not *paṁti*. Read the text as °vad°.

⁹ The last letter, i.e. the *visarga*, is clear on the facsimile, but Kern placed it within brackets.

¹⁰ The *virāma* has been denoted by a semicircular stroke above the last letter. We miss this form in the Kalasan inscription.

5. bhaktiprahvairmunīndrairabhinutamasakṛt svargganirvvāpaheto-
rddevairlekharṣabhādyairavanatamakūṭaiścumvitam ṣa [6] tṛpadā-
bhairh
aṅgulyātāmrapatram nakhakiraṇaḥsatkesarārañjitāntam
deyāt śam śāśvatamvāstrinayanacara [7] nāninditāmbhojayug-
mam || 3
aiśvaryyātīśayodbhavātsumahatāmapyadbhutā(nām n)idhi-
styāgaikāntaratastanoti [8] satatam yo vismayam yoginām
yo śābhistanubhirjagatkaruṇayā puṣṇāti (na svārtha)to
bhūteśaśāśikhaṇḍabhū[9]ṣitajataṣsa tryamvakah pātu vah || 4
vibhraddhemavapussvadeh¹adahanajvālā ivodyajjātā
vedastambhasuba [10] ddhalokasamayo dharmmārthakāmodbhavaḥ
devairrvanditapādapaṇkajayugo yogīśvaro yoginām
mānyo loka [11] gururddadātu bhavatām siddhiṃ svayambhūrvvi-
bhuh || 5
nāgendrotphaṇaratnabhittipatitām dr̥ṣṭvātma vimhaśriyam
sabhrū [12] bhaṅgakaṭākṣayā kupitayā nūna(m)² śriyā vīkṣitah
yo yogārūṇalocanotpaladalaśśetembuśayyāta[13]le
trānārthantridaśai(s)stutassa bhavatāndeyāt śriyam śrīpatiḥ || 6
āśiddvipavaram yavākhyamatula(ndhānyā) [14] divijādhikam
sampannam kanakākaraistadamarai mantrādino³pārjitam
śrīmatkuñjarakuñjadeśanihi(tam ga) [15] ṅgāditīrthāvr̥tam⁴
sthānandivyatamam śivāya jagataśśambhostu yatrādbhutam || 7
tasmindvīpe yavākhye puruṣa(pada) [16] mahālakṣyabhūte⁵
prāśaste
rājogrodagrajanmā prathitapr̥thuyaśāśmadānena samyak
śāstā sa(rvva pra)[17]jānāñjanaka iva śīśorjanmato
vatsalatvātsannākhyassannatāirmmanuriva sucirampāti dhar-
mmeṇa p(r)thvī(m) || 8
[18] evaṅgate samanūsāsati rājyalakṣmīm
sannāhvayenvayavidhau samatītakāle
svargge s(ukham phala)ku(lo) [19] pacitamprayāte
bhindañjagadbhramati śokavaśādanātham || 9
jvalajjvalanavidravatkanakagauravarṇa (dyutiḥ)⁶
(br)⁷ [20] hadbhujanitamvatuṅgatamamūrdhaśr̥ṅgonnataḥ
bhuvī⁸ sthitakulācalakṣitidharoccapādocchrayaḥ
(prabhūta) (21) guṇasampadodbhavati yastato meruvat || 10
śrīmānyo mānaniyo vudhajanānikaraiśśāstrasūkṣmārtha(vedī)
(rā) [22] jā śauryyādiguṇyo raghuriva vijitānekaśā(mantaca)kraḥ
rājā śrīsañjayākhyo raviriva ya(śasā di) [23] gvidikkhyātalakṣmī
ssūnussannāhanāmnassvasura (samagūṇaiḥ nyā)⁹yataśśāsti
rājyam || 11

¹ Kern reads °doṣa° but °deha° is clear. Chhabra's reading tallies with ours.

² Kern reads *duram*, but *nūn*° is clear. See this word in the last line. Chhabra also reads *nūn*°.

³ Chhabra suggests: *svarggā*°, but the writing of the word in l. 18 is different. I have doubtfully read this word as *mantrā*°.

⁴ Kern reads °*nīhitavamśāditivādhṛtam*, but that violates the metre. In Chhabra's facsimile, the second *ku* in the compound is not so clear.

Chhabra reads this word as given above, and this reading is now generally accepted. Stutterheim in *TBG*, 79 (1939), pp. 75ff., has tried to establish the fact that *kuñjara-kuñja* as well as *gaṅgā* of this inscription are to be located in Java.

⁵ Chhabra reads: °*lakṣma*°.

⁶ See *JASBL*, I, p. 36.

⁷ I do not find way to accept Chhabra's readings.

⁸ The verse may also be filled in in the following way: °... *svasura(mitaguṇaḥ)* *nyā*°....

⁹ *Ibid.*, p. 35, f.n. 5.

yasmiñchāsa(ti sāga) [24] rormmiraśanām śailastanīmmedinīm
 śete rājapathe (jano na) cakitaścorairna cānyairbhayaiḥ
 kīrttyā(ḍhyairalama)[25]rjjitāśca satatandharmmārthakāmā
 nūnaṃ roditi roditīti sa kalirnnāsyāṇśa¹(śeṣo yataḥ) || 12

Translation

1. When the year of the Śaka king that is brought to numbers with four, five and six (654) was passed, on Monday, the thirteenth day of the bright half of the month which follows (the *tithi*) Bhadrā², in (the month) of Kārttika, while the *lagna* stood under *Kumbha* in the part³ called 'fixed', the king (who is) the illustrious Sañjaya⁴, established on the hill a *linga*⁵ with (all) auspicious marks.

2. He who is a Sun in the darkness of the world; who has for his crest-jewel the Moon on his matted locks which are beautified by the surging waves of the Ganges; on whose body dazzling with the brilliance of ashes, scatters its brilliance the necklace of snakes; who is praised by the gods with graceful and soft palms (of their hands) folded in the form of a vessel; he, Śiva, may bestow on you the most perfect bliss!

3. May that irreproachably beautiful pair of feet-lotuses of the three-eyed one (Śiva) which are constantly praised by the greatest of sages by bending low in homage for their salvation in heaven; which are kissed by the greatest of gods and demons and others with their bent crowns which are (comparable to) the bees (that kiss the lotus); whereof the slightly copper-coloured petals are the toes and whereof the end is decorated by bright filaments of rays (issuing) from the nails; may (that pair of feet) grant you perpetual bliss!

4. May the three-eyed one (Śiva) whose matted locks are adorned with the crescent moon; who by reason of excess of his divine attributes is a receptacle of great and, even, wonderful things; who, given to solitude, by his renunciation (of all things), always creates the wonder of *yogins*; who, by his eight-fold bodies⁶ and through compassion but not selfishness, sustains the universe; may he, the lord of (all) beings, protect you!

5. May the self-created Lord (Brahmā), the object of worship of the world, whose pair of feet-lotuses are revered by the gods; who has fixed the regulations of the world to the post of the *Vedas*; who is the source of religion, worldly prosperity and desire; whose body dazzles like gold and

¹ Kern's reading of °*stya*° is very doubtful.

² That is *dvādaśī*. Bhadrā is a group of the following *tithis*, viz. *dvitīyā*, *saptamī* and *dvādaśī*.

³ By 'part', one-ninth of an astrological house is meant. See Kern: *VG*, VII, p. 121, f.n. 1.

⁴ In an inscription of Kēdu, a king Sañjaya heads the list of Matarām kings. He is identical with king Sañjaya of our inscription. See *TBG*, 67 (1927), pp. 172-215.

⁵ Dr. Bosch has developed a theory which seeks to establish a relation between *Siva-linga*, the reigning dynasty and the foremost Brāhmaṇa. According to this theory, the king appears on earth in the place of Śiva and his royal prowess is personified in the *linga*. The Brāhmaṇa, who is the mediator, receives this ore-*linga* of Śiva and presents it as a palladium to the founder of dynasty. Dr. Bosch has also tried to show that this tradition was current not only in Java, but also in Campā and Cambodia. For full particulars see *TBG*, 64 (1924), p. 230ff.

⁶ Śiva's eight-fold bodies consist of the five elements and mind, egotism and matter. In place of the last three we have also the Sun, the Moon and the sacrificing host (Yajamāna). Cf. the prelude to Kālidāsa's *Abhijñāna-Sakuntalam*.

whose matted locks are comparable to the flames of the fire of his own body; may he the lord of *yogins*, the venerable one,¹ reward you with success!

6. May he, who lies on the surface of the watery bed, the petals of whose eye-lotuses are red through meditation; who is behymned by the gods for protection; who is always frowningly viewed by the goddess Śrī² on seeing the beauty of her own image reflected on the side-levels of the jewels on the up-turned crown of the king of serpents; may he, the lord of Śrī, grant you prosperity!

7. There is³ a great island called Yava, abundantly supplied with rice-grains and other seeds and rich in gold-mines.⁴ That (island) is acquired by the immortals (by *mantras*) and other means; where there is a wonderful place dedicated to Śambhu, a heaven of heavens, surrounded by the Ganges and other holy resorts and laid in a beautiful woodland inhabited by elephants,⁵ existing for the good of the world.

8. In that excellent island called Java which is the great mark of footprints of Puruṣa,⁶ there was a king of very noble lineage of the name of Sanna who was of established reputation and who, by means of conciliation and gift, ruled the subjects in a proper way, out of attachment, just like a father (taking care of) the child from his very birth and who with his enemies subdued, protected the world for a long time with justice like Manu.

9. He (the king) named Sanna, the (very) Moon of the family, while thus ruling over the goddess of royalty, having, in the fullness of time, gone to enjoy happiness in the heaven which is the accumulated results (of his meritorious deeds). (Then) the earth, separated (from him) roamed in grief for being bereft of her lord.

10. The one who sprang from him⁷ was like the (Mount) Meru and possessed a wealth of manifold qualities: he has the splendour of the bright

¹ In the use of the word *mānyo*, Dr. Poerbatjaraka (*Agastya*, pp. 2, 44ff.) sees an allusion to Agastya. That is extremely improbable here, because Agastya is never associated with Brahmā and, moreover, he is not *Svayambhū* but *Kumbhayoni*. I think that these verses are devoted to the praise of the Trinity.

² The goddess of wealth.

³ Lit. there was.

⁴ On the problems of gold-mines in Java, see Krom: *Geschiedenis*, p. 58, and the literature cited thereon.

⁵ A *kuñjarakuñjadesa* is otherwise unknown in Java. Indeed, it seems to be no geographical name at all. The romance of *kuñjarakuñja* thus disappears, leaving in its place a beautiful woodland inhabited by elephants. The hilly terrain of Gunung Wukir with its forest region or some parts of the Kedu-plains near the foot of the hill may be the beautiful woodland inhabited by elephants. The abode of God Śambhu was thus laid deep inside that forest area. The significance of the word *nihitam* is properly revealed by this interpretation. It is not unlikely, though not certain, that the *linga* established by Sañjaya 'on the hill', as stated in *śloka* 1, was installed in the 'wonderful place dedicated to Śambhu' is the 'beautiful woodland inhabited by elephants', as described in *śloka* 7. So it is not really necessary to search for *kuñjarakuñja* in Java or Southern India.

Stutterheim in *TBG*, 79 (1939), p. 78, suggests that *tirthāvṛtam* can pertain either to *dvīpavaram* or *sthānam*. This is not probably correct. The first rib of the verse ends with *kanakākarañh*, because the very next one begins with *tad* (= that island) and ends with *upārjitam*. The third one runs from '*śrīmat* *adbhutam*'. My translation given above follows this context and structure of the *śloka*.

It is also not necessary to search for Gaṅgā of this inscription in Java. Because, according to Sanskrit and Javanese rituals, Gaṅgā could be invoked anywhere and any stream, however insignificant, could have then attained the sanctity of the Ganges. The case of Tuk Mas may be recalled in this connexion.

Previous views regarding *kuñjarakuñja* may be studied in Krom: *op. cit.*, p. 125; Kern: *op. cit.*, p. 122; *JGIS*, III, pp. 170-77; Stutterheim: *op. cit.*, p. 75ff.

⁶ Cf. Chhabra: *op. cit.*, p. 36.

⁷ *Tatah* in the text can also mean: 'who rose thereupon'. Many instances can be cited from Sanskrit literature in favour of this use of *tatah*. Besides, the clear statement in l. 23 *sūnuṣaṇḍhaṇḍhaṇaḥ* confirms the rendering given above.

colour of the gold that has been smolten in the flaming fire; he has great arms, big thighs and head upraised like the mountain-peaks, and has the shelter of his high-raised feet on the kings of stable dynasties obtaining on the earth.

11. The illustrious king called Sañjaya, who is beautiful and respected by the assembly of the learned as an adept in the subtle meanings of *sāstric* lore; who, excelling in bravery and other virtues, has, like Raghu,¹ overthrown many circles of feudal lords;² who is like the Sun in fame and whose splendour spreads in all regions; he, the son of Sannāha,³ is (now) ruling the kingdom justly through his own (virtues comparable to those of the gods).

¹ The exploits of Raghu were popularized by Kālidāsa. See *Raghu-vaṃśam*, IV, 26-88.

² On the circle of kings, see Kauṭilya's *Arthasāstra*, Bk. VII-VIII.

³ If we read the text as: *sūnussannāhanāmnassvasura (mitagunaiḥ nyā) yat-aśśāsti rājyam*, we can translate the verse in the light of Vogel's ingenious suggestion as quoted by Chhabra in *JASBL*, I, p. 37, viz. 'he, the son of the sister of the (person) named Sannāha, is (now) ruling the kingdom justly (with immeasurable virtues)'. This interpretation is apparently corroborated by the fact that the list of Matarām kings, as given in the Kēdu inscription (*TBG*, 67, pp. 172ff.), opens with Sañjaya, and not with Sannāha. If Sañjaya had been Sannāha's son—and not the son of Sannāha's sister—the list of Matarām kings should have opened with Sannāha. This argument is not, however, as formidable as it appears at first sight. As a matter of fact, this phenomenon seems to lend corroboration to the theory of Dr. Bosch described earlier. It may be stated in that context that since Sañjaya installed the Śiva-*linga*—Sannāha is not known to have installed any—and since this *linga* thereby became the protector of the dynasty, posterity looked upon this founder of Śiva-*linga*, viz. Sañjaya, as the real founder of the dynasty. If this interpretation explains the omission of Sannāha from the Kēdu list, there remains no other independent testimony to justify the conjectural interpretation of the verse by 'the son of the sister of the person named Sannāha...'. Besides, it may be pertinently asked: many Javanese inscriptions have referred to lesser princesses; why could not the poet, who devoted many verses to the eulogy of Sannāha and Sañjaya, spare a single word either for the name or in praise of the so-called 'sister'? A 'sister' changing a dynastic line and happening to be the Queen-mother of Sañjaya was not an ordinary person to be omitted by the court-poet. In addition to these circumstances, the following considerations urge the cancellation of the interpretation of the verse by 'sister' and acceptance of the translation given above. Firstly, the word *yastato* occurring in verse 10 can very well mean 'the one who sprang from him', i.e. from Sannāha. Secondly, the 11th verse describes him as *sūnuḥ sannāhanāmnah*, i.e. the son of the person named Sannāha. Thirdly, tradition as embodied in the *Carita Parahyangan* (*TBG*, 59, pp. 403, 416ff.) describes Sañjaya as the son of Sēna (Sanna).

Some scholars suggested previously that king Sañjaya ruled with his sister; if so, the poet was bound to use the third case-ending for *svasṛ*. The use of the sixth case-ending shows that the word is connected with *sūnu*. Secondly, the very next verse opens with *yasmiñchāsa(ti)*. If Sañjaya ruled with his sister, this should have been couched in the dual number. The use of the singular number indicates that he ruled alone.

THE TECHNIQUE OF THE MANUFACTURE OF STONE
BEADS IN ANCIENT UJJAIN

By N. R. BANERJEE

The purpose of this article is to describe the technique of the manufacture of stone beads as developed in ancient Ujjain round about *circa* 200 B.C. The inference is deduced from scattered evidences obtained by the recent excavations at Ujjain conducted by the Union Department of Archaeology. Incidentally, endeavour would be made to show, by comparison with the technique more anciently in vogue and adapted in modern times, the antiquity of the tradition.

In the 'Uttarmegha' of Kālidāsa's *Meghadūtam* occurs the following *śloka*¹ which purports to endow Ujjain of Kālidāsa's days² with immense riches :

हारांस्तारांस्तरुगुटिकान् कोटिशः शंखशुक्लौः
शुक्लश्यामान् मरकतमणौनुन्मयूखप्ररोहान् ।
दृष्ट्वा यस्यां विपणिरचितान् विद्रुमाणां च भंगान्
संलक्ष्यन्ते सलिलनिघयस्तोयमात्रावशेषाः ॥

Shorn of its poetic exaggeration it simply means that Ujjain was rich with, among others, precious stones. The *Periplus of the Erythraean Sea*,³ the work of an unknown author of the first century A.D., describes Ujjain as a source of precious stones, such as agate and carnelian, which were exported to Barygaza and thence to the western world. By the first century A.D. the quarries of Ujjain were well known enough to have merited the description given by the author of the *Periplus*.

The Nasik inscription of Vāsiṣṭhiputra Pulumāyi⁴ and the Junagadh inscription⁵ of the Śaka ruler Rudradāman mention among the territories within their domains the names among others of Ākara and Avantī. While there is a general agreement about Avantī meaning the country around Ujjayinī, there is a controversy over the interpretation of Ākara. Dr. Bhandarkar⁶ thought that there were two 'Avantis', one in the north with Ujjayinī as its capital and the other in the south with Māhiṣmatī (Maheswar on the Narmadā in district Nimar, Madhya Pradesh). Dr. Malalasekhara,⁷ on the other hand, thinks that Ujjayinī rose into prominence only after

¹ *Meghadūtam*, edited by S. K. Dey, Sahitya Akademy, New Delhi, 1957, p. 50. Mallinātha includes this verse but regards it as interpolated.

² It is not intended to enter into the controversy among scholars raging over the age of Kālidāsa, which according to different accounts ranges from the first century B.C. to the fifth century A.D. It would be worth while, however, to mention that the earliest inscriptional reference to Kālidāsa occurs in Pulakesi's inscription at Aihole, dated to A.D. 634-35 (*Indian Antiquary*, VIII, pp. 239-40).

³ *The Periplus of the Erythraean Sea*, translated by W. H. Schoff, 1912, sections 48 and 49, p. 42.

⁴ Senart : *Epigraphia Indica*, VIII, pp. 60ff.

⁵ Kielhorn : *Epigraphia Indica*, VIII, pp. 42ff.

⁶ R. G. Bhandarkar : *Garmichael Lectures*, 1918, p. 54.

⁷ Malalasekhara : *Dictionary of Pali Proper Names*, I, p. 344.

the decline of Māhiṣmatī. *Purvāpara-Ākarāvanti*, occurring in Rudra-dāman's inscription, have also been identified as Eastern and Western Malwa¹ respectively.

*Ākara*² in Sanskrit means a mine or a rich source of anything and its meaning can be extended to mean quarries. This will cover the quarries from which agate, carnelian, jasper, and onyx could be collected. Incidentally, 40 miles to the north-east of Ujjain is a little township called 'Āgar'. The area around it bears indications of ancient habitations and it is also known as a source of iron ore. Here, therefore, is a possible interpretation of the word *Ākara*.³ Incidentally, ample evidence of the use and manufacture of iron at Ujjain itself has been revealed by the recent excavations⁴ at Ujjain by the Union Department of Archaeology between 1956 and 1958, during the period *circa* 500–200 B.C. In fact, the use of iron has been observed to have existed at Ujjain even prior to this date.

At Ujjain itself lumps of chalcedony, agate, carnelian, onyx, and iron ore in the form of limonite occur in the trap subsoil. In the absence of any definite evidence the word *Ākara* has either to be taken as a noun naming either the region around Āgar, or as an adjective characterizing the Avantī country, meaning Avantī abounding in quarries (of minerals and rocks). The *Periplus of the Erythraean Sea* also lends support to this inference.

A recently published *Bulletin of the Geological Survey of India*⁵ dealing with the mineral resources of 'Madhya Bharat' (now incorporated in Madhya Pradesh) contains the following relevant description :

'Although varieties of agate and chalcedony are likely to be found at many places in the trap area, there is no local industry for cutting and polishing these stones. These minerals are known to occur at many places in the amygdaloidal basalts of the Shajapur, Ujjain, Bhilsa and Mandasor districts.'

The mineral resources of 'Madhya Bharat', which covers the area around Ujjain, lend support to the suggested interpretation of the term 'Ākara-avantī'.

The excavations at Ujjain have revealed that Ujjain was not merely rich in the semiprecious stones mentioned above, but that the materials were worked locally for the manufacture of stone ear-ornaments and beads from very early times. The excavations have shown continuity of human habitation in the area from about 750 B.C. to about A.D. 1400, divided into four periods,⁶ called respectively Period I (*circa* 750–500 B.C.); Period II (500–200 B.C.); Period III (200 B.C.–A.D. 1300); and Period IV (A.D. 1300–1400). Like the evidence on the manufacture of mirror-like polished ear-ornaments (Pl. I), the much larger evidence on the manufacture of beads is available both in Periods II and III, though it is mostly confined to the lower levels of Period III, not very far removed, therefore,

¹ H. C. Rayachaudhuri: *Political History of Ancient India*, pp. 491, 506.

² Monier Williams: *A Sanskrit-English Dictionary*.

³ Rayachaudhuri: *op. cit.*, p. 491, note No. 5; *Bombay Gazetteer*, Gujarat, 540; *Epigraphia Indica*, XXIII, p. 102.

⁴ *Indian Archaeology—A Review*, 1955-56, p. 19; 1956-57, pp. 20-27; 1957-58, pp. 32-36. N. R. Banerjee: 'The Excavations at Ujjain', *Indologon Tagung*, Essen (West Germany), 1959.

⁵ M. K. Roychowdhury: *Bulletin of the Geological Survey of India*, No. 10, p. 33.

⁶ These Period divisions are tentative and without, at the moment, any consideration of sub-Periods. The finalization of the sub-Periods must await the study of the coins and other cultural materials, recovered from the excavations, which is, however, in hand.

from *circa* 200 B.C. Nevertheless finished beads of stone as well as terra-cotta occur at Ujjain in considerable numbers, owing their occurrence either to import or local manufacture, even in Period I.

The evidence consists, largely, of (a) lumps of raw material (Pl. II), mainly agate, and also carnelian, (b) heaps of unfinished beads¹ (Pls. II and III) in the form of rough-outs, (c) sandstone-grinding slabs (Pl. II) marked, as a result of grinding, with multiple deep and long grooves, (d) channel or longitudinal trench or channel ovens² (Pl. IV), containing a rather meagre scatter of ash and charcoal, and (e) earthen vessels³ (Pl. II) containing the unfinished beads, in one case provided with a neatly-made chalcedony stopper (Pl. III). These occur on the mud floors of the mud houses of the period, located over the inner slopes of the eastern wall of the mud fortification and also in the southern part of the fortified area.⁴ The floors are covered, as the excavations revealed, with the debris of fallen roofs made of burnt tiles. Like the finished beads obtained in the excavations the unfinished ones too display a wide variety of shapes, though the latter do not more than generally indicate the desired shape in outline.

Ujjain has indeed yielded a wide variety of beads in divergent shapes (Pl. V) and in diverse materials. The variety of shapes as well as of materials must be in accordance with the prevailing taste or fashion and, inescapably, the length of the contemporary purse. Nevertheless, the shapes in one material always influence shapes in other materials, following the vicissitudes of changing fashions. As the scope of this article is confined to stone beads, on the ground of the identity of the technique involved in producing them, the shapes of unfinished beads (Fig. 1) in stone alone are considered here.

In all a little over five thousand stone beads were found in the recent excavations. Of these only 3 belong, significantly enough, to Period I, 16 to Period II, 5,011, including two separate hoards of 3,646 (Ujn.-12) and 1,296 (Ujn.-4) respectively, to Period III and only 34 to Period IV. The materials used comprised agate, carnelian, soapstone, garnet, jasper, quartz, crystal, steatite, aquamarine, jade, chalcedony and onyx. The shapes (Pls. VI and VII), in spite of the crude forms, comprise square, rectangular, cylindrical, globular, truncated biconal with square facets, biconal-truncated, barrel-shaped, truncated-biconal-hexagonal, tubular, ovoid, pyramidal, spherical, plano-convex and discoid, besides diamond-shaped.

The grinding slabs are almost tell-tale in shape and function. Some finished and semi-finished specimens easily fit into the grooves. The length of the grooves seem to suggest that grinding was done by long strokes. The beads were held in some kind of holder for grinding. Grinding served to remove the external angularities and smoothen the uneven surfaces, and was only the prelude to the final finishing or polishing with some abrasive material.

The channel ovens are apparently channel-like depressions, lined with clay, and contain ash and charcoal. The clay-lining is usually hardened by the contact with fire. That these were meant to bear such fuel, possibly animal dung and some wood, as produced only a gentle heat is indicated

¹ *Indian Archaeology—A Review*, 1956-57, p. 27; Pl. XXXIIIB.

² *Indian Archaeology—A Review*, 1956-57, p. 27; 1957-58, p. 34; Pl. XLIIA.

³ *Indian Archaeology—A Review*, 1957-58, p. 34.

⁴ Cf. Kautilya's *Arthashastra*, translated by R. Shamasastry, 4th edition, 1951, p. 3. To quote, 'The treasury, the accountant's office, and various manufactories shall be situated on sites south by east.' Incidentally, the evidence for the manufacture of iron objects, beads, bone arrowheads, are either in the east or south-east of the fortified area at Ujjain.

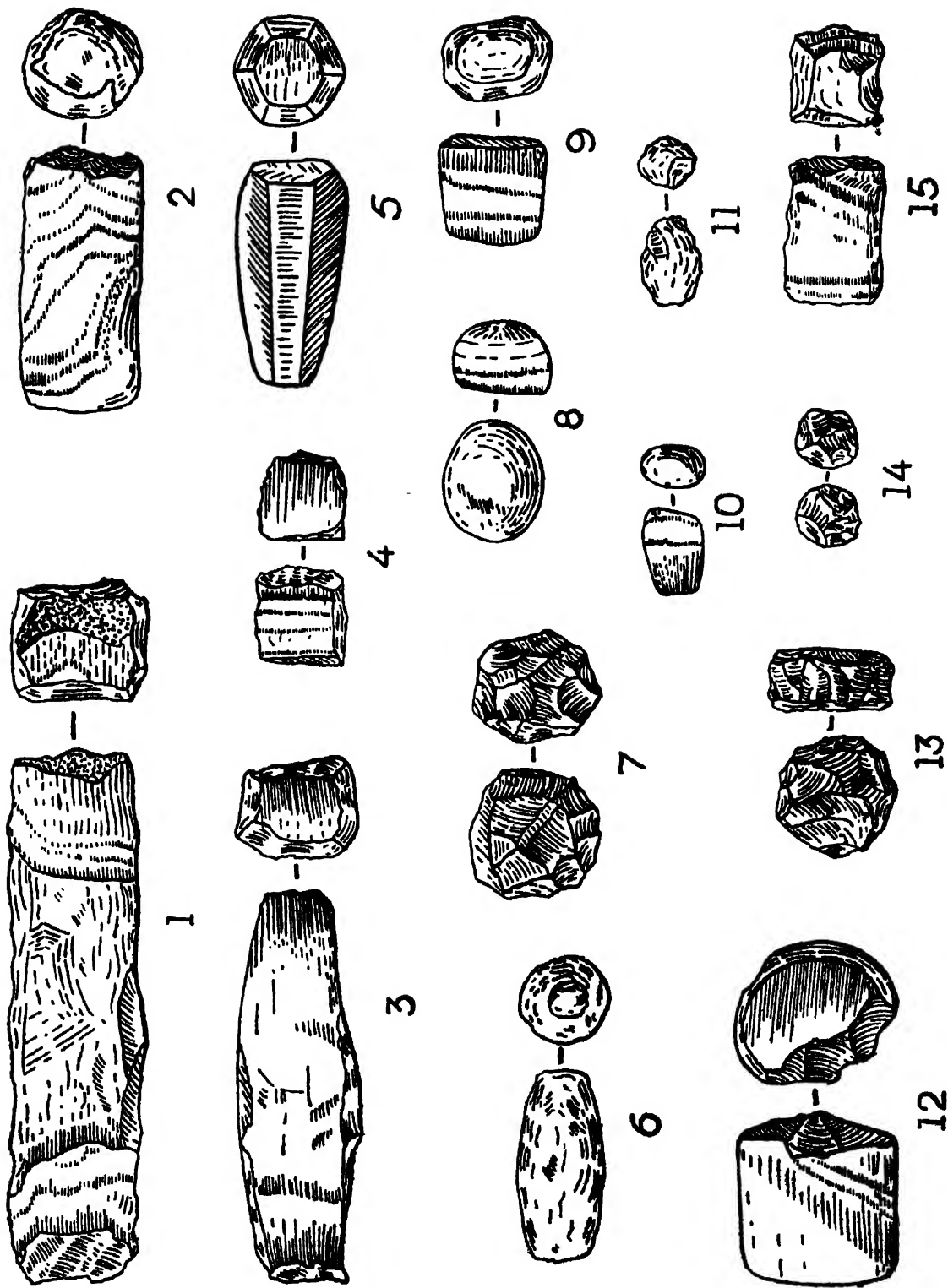


FIG. 1. Typical shapes of unfinished beads in the making. Not to scale.

not merely by the small quantities of charcoal and ash that they contain, but also by the fact that the sides lined with clay are not burnt hard.

From these bits of evidence it is easy to work out the complete process of the manufacture of beads obtaining in ancient times. The lumps of agate or such other materials, as were used, were first chipped to small pieces or lumps, and from these chips or flakes were removed in the same manner in which flakes are struck off lumps or nodules of stone for the preparation of microliths. The examination of a large number of flakes thus removed showed only a pronounced bulb of percussion, but no signs of retouching. The flakes, too, because of the irregularity of shapes and thinness, were obviously only waste flakes. The flakes were detached skilfully enough to produce the desired shapes of beads in rough outlines. These were then placed in pots, the mouths of which were tightly closed by well-fitting stoppers of the same stone, and the pots were placed on the channel ovens,¹ possibly several in a line, to subject the roughly-made beads to a slow heat. Occasionally a few ground, but otherwise unfinished, beads were also thrown in, for the tinting treatment. It is well known that the stones used in the manufacture of beads respond to applications of heat, lighter shades changing into deeper ones. The practice of obtaining desired tints for the finished products was thus known to the ancient bead manufacturers of Ujjain. The use of the tight-fitting stopper of stone, namely chalcedony, was apparently to prevent the applied heat from escaping too quickly through gaps in the mouth and thus ensure uniform heat inside resulting in uniform tinting of the beads. In this context the method adopted by the bead makers of Cambay even today deserves consideration. Even the mere exposure to the heat of the sun would give results, but would take more time; hence presumably the practice of heating was adopted.

Possibly at some intermediate stage between grinding and polishing the beads were perforated. The perforation was attempted from both ends, as the perforation was not in a straight line but formed a very obtuse angle (Pl. VIII) midway through the axis. This is deduced from some finished as well as unfinished beads having the perforation. The grinding was done with the help of some abrasive material, as the mere act of rubbing on the stone surface, without the abrasive intermediary, as experimentally observed, does not yield the desired results. This material may have been powdered quartz, which is available locally. Corundum, which serves as a good abrasive, is, however, available largely in the Morena district, but there is no evidence to show that this was used anciently at Ujjain, and, as observed by the geologist (p. 190 *ante*), there is no living industry involving the cutting and polishing of stones in the region.

Cambay, in the estuary of the Narmadā, in district Cambay, Gujarat State, is known from very early times for its bead industry, which enjoyed until recently considerable patronage from Africa. The influx of artificial material, particularly of glass, which caters to a variety of tastes for colour and design and shape has recently endeavoured to push the trade out of existence. However, the earliest reference to the export of raw materials from the port of Barygaza is provided by the evidence of the *Periplus*.² In the medieval times reference to the industry of Cambay and to the export of beads by Mohammedan traders to Red Sea and east-west of Africa was

¹ Cf. W. H. Schoff; *The Periplus of the Erythraean Sea* (translation), 1912; note under Section 49, pp. 193-94; G. Watt: *The Commercial Products of India*, 1908, pp. 561-62.

² *The Periplus of the Erythraean Sea* bears ample references to the port of Barygaza.

made in the writings of Duarte Barbosa.¹ Even today many a household at Cambay is humming with the manufacture of beads, particularly of agate and carnelian. The process of manufacture followed at Cambay today is borne out by the archaeological evidence at Ujjain to be a continuity, barring improvements which passage of time and attendant advance in technology have contributed, of the early industry.²

The process of manufacture adopted at Cambay is briefly described below.

The material was selected by the bead makers with an eye on its tinting potentiality and was collected from different parts of India. The stones were allowed to be heated by the sun for a fairly long time. They were subsequently put in a shallow pot and heated gently with goat- and cow-dung for a day or two. An alternative modern method is to lay the selected stones on the plain ground in a rectangular area, sprinkle the stones with ash to prevent contact with saw-dust, and cover the stones thus prepared with burning embers of charcoal making the saw-dust to burn and heat the stones for a period of 24 hours. After the heating or baking, the stones are cooled and washed clean. Stones are then sawn suitably with a toothless saw. Smaller pieces are then held against the tip of an iron pike (Pl. IX) driven almost fully into the ground with only the point exposed, and struck in the desired manner with a horn-headed wooden mallet (Pl. IX), and flakes removed till the desired shape is obtained (Pl. X).³

The rough-outs, obtained in the manner described above, are then smoothened by rubbing first against a hard and coarse slab of stone and then against a grooved wooden board covered with seed lac and emery powder. Next, the polishing is done by holding the beads against a suitably-made lathe disc, made either of wood or copper according to the hardness of the stone, covered with seed lac and emery powder. The beads are then placed in a leather bag containing emery powder, and it is moved back and forth by means of a leather thong for nearly two weeks. In modern times this method has been further modified. The unfinished beads are placed in a wooden drum together with an abrasive powder, and the drums are made to rotate mechanically, resulting in smoothening of

¹ *The Book of Duarte Barbosa*, translated and edited by M. L. Dames (Hakluyt Society, 1918).

² The bead industry at Cambay is described at some length in an article on 'Cambay and the Bead Trade' by A. J. Arkell in *Antiquity*, Vol. X, No. 39, September, 1936, p. 292ff.

³ I am indebted to Dr. M. G. Dikshit of the Nagpur University for the following information:

The 43rd *adhyāya* (chapter), called *Dushtāṅga-Bhedana*, dealing with the chiselling of defective portions of a diamond or jewel, of a manuscript entitled *Ratna-Sāstra Samhitā*, attributed to Agastya, throws an interesting light on the manufacture of beads in medieval times. This work is considered by Dr. Dikshit to be of the tenth century A.D. or even of an earlier date. It is now lodged in a private collection at Calcutta. Verse No. 6 of the 43rd *adhyāya* of the above-mentioned manuscript reads as follows:

“ नीलिकस्यैव रत्नस्य पुटभेदः प्रदक्षते
 चारुस्रवणक्षेदाद्वत्तं तेषामस्त्रिपाचितं
 मेघशृङ्गवत्तं दृष्टं पुटं त्यजति मान्यया । ”

The same is translated thus:

‘The layers in the gem should be removed in the same manner as in the pearl, but it should first be well processed in *kshārāmlalavana* (an acid preparation which is earlier described in this work) without which the beating by a (hammer made of) ram’s horn would not remove the *puṭa* (layers or flakes).’

This is the earliest literary evidence of the use of the horn-headed wooden mallet for detaching flakes, and may be based upon tradition dating from a still earlier date.

the rough-outs. Finally, the finished beads are bored with a diamond-tipped steel drill. The method thus in vogue today compares very favourably with the methods adopted by the ancient bead makers of Ujjain. Here and there some evidence may be lacking, in respect of the polishing or boring apparatuses. Even so it may be deduced that the ancients possibly knew the use of some kind of a lathe, as some of the ear-ornaments, completely circular in shape, would suggest. Some of the beads are absolutely of uniformly circular cross-section. The tool used for perforating is indeed a matter of guess.

The human desire for decoration or ornaments being as old as man himself, it is not to be wondered at that the earliest civilization known in India, namely the Harappan, has yielded large numbers of beads, the simplest of decorative equipments, in a wide variety of forms and materials. That not all the beads that the Harappans used were imported from outside is clearly proved by many unfinished specimens suggesting local manufacture.¹ The unfinished beads, most of which were of agate, were first flaked from lumps into the rough form of the desired shape. They were then rubbed against a stone for smoothening. At this stage, the perforation was undertaken from one end at a time. Often-times the twin perforations, that met midway, were not in a straight line. After the boring the beads were subjected to polishing again, with the help of an abrasive.

The evidence of the processes of manufacture of beads in general at Chanhudaro² marked a similarity of the method in Harappan as well as the entire Jhukar and Jhangar phases. The lumps were first removed from the nodule by sawing. The rough-outs were prepared in the same manner as the beads of Ujjain, namely by flaking (pp. 211, 214) from the lumps. They were then ground against a hone or a block of sandstone slab, some of which are marked by grooves, as a result of vigorous rubbing against it, possibly with the help of an abrasive and/or water. Next the holes were bored with stone drills,³ varying in length up to 2.43 inches and about 0.12 inch thick, and made usually of chert. The stone drills, intact as well as damaged, are found in large numbers, and have a slight depression at the working end to contain a little abrasive and water to give it a firm grip on the rough-out. The perforations being the result of boring from opposite ends, they often meet at a ridge or angle causing the cord or string which was passed through to complete a necklace or such other ornament to snap or break in the course of use. The material had a large variety and included, apart from steatite, agate, carnelian, onyx and other semiprecious stones.

Thus the tradition of the art of bead making in ancient Ujjain can claim to have its beginnings at the very dawn of civilization on Indian soil. Examples of the local manufacture of beads in ancient India in the form of unfinished specimens are far too multitudinous to need any specialized treatment. The Ujjain evidence on the whole is comprehensive and lends itself more easily to interpretative effort in the light of the contemporary practice at Cambay. Thus the literary and archaeological evidences and existing practice are seen to complement one another and combine in

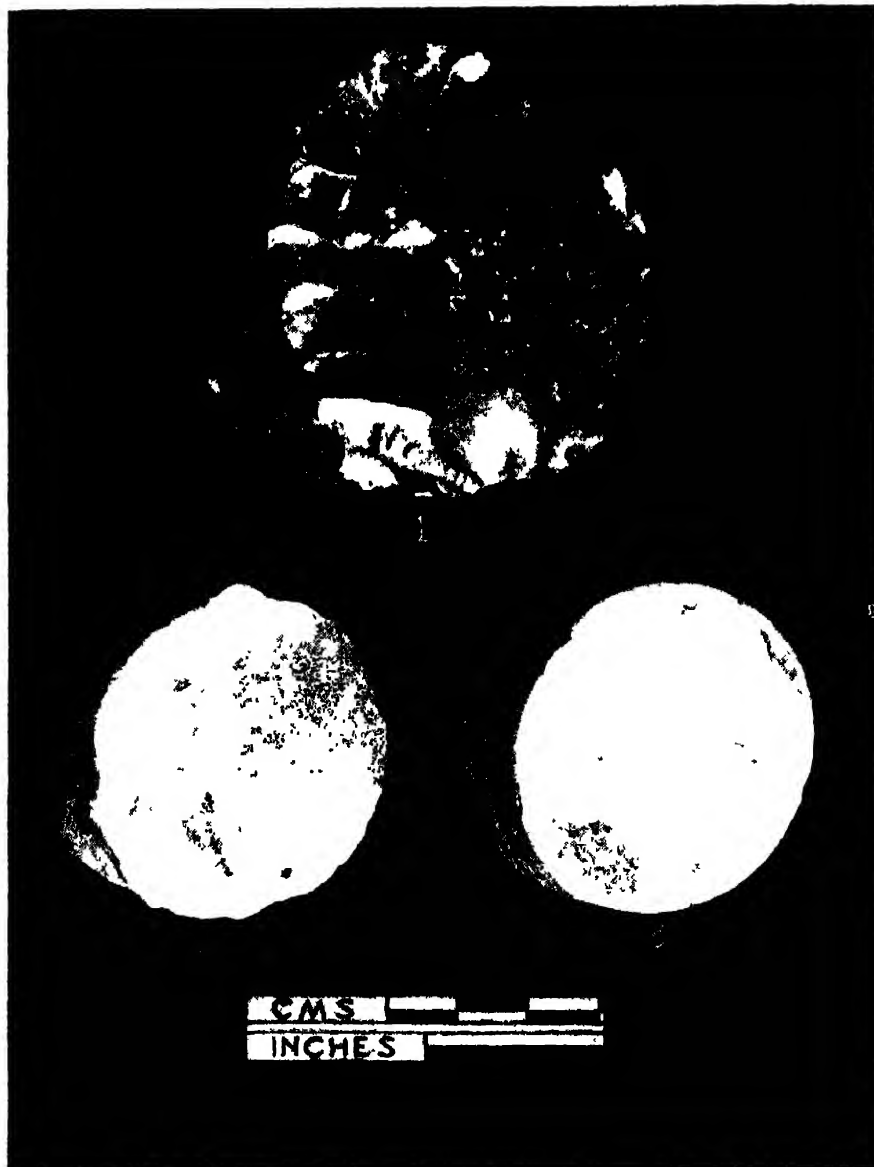
¹ E. J. H. Mackay: *Further Excavations at Mohenjodaro*, pp. 502-3.

² E. J. H. Mackay: 'Bead Making in Ancient Sind', *Journal, Amer. Oriental Society*, Vol. 57, pp. 1-15; *Chanhudaro Excavations* (1935-36), American Oriental Series, Vol. 20, 1943, p. 324.

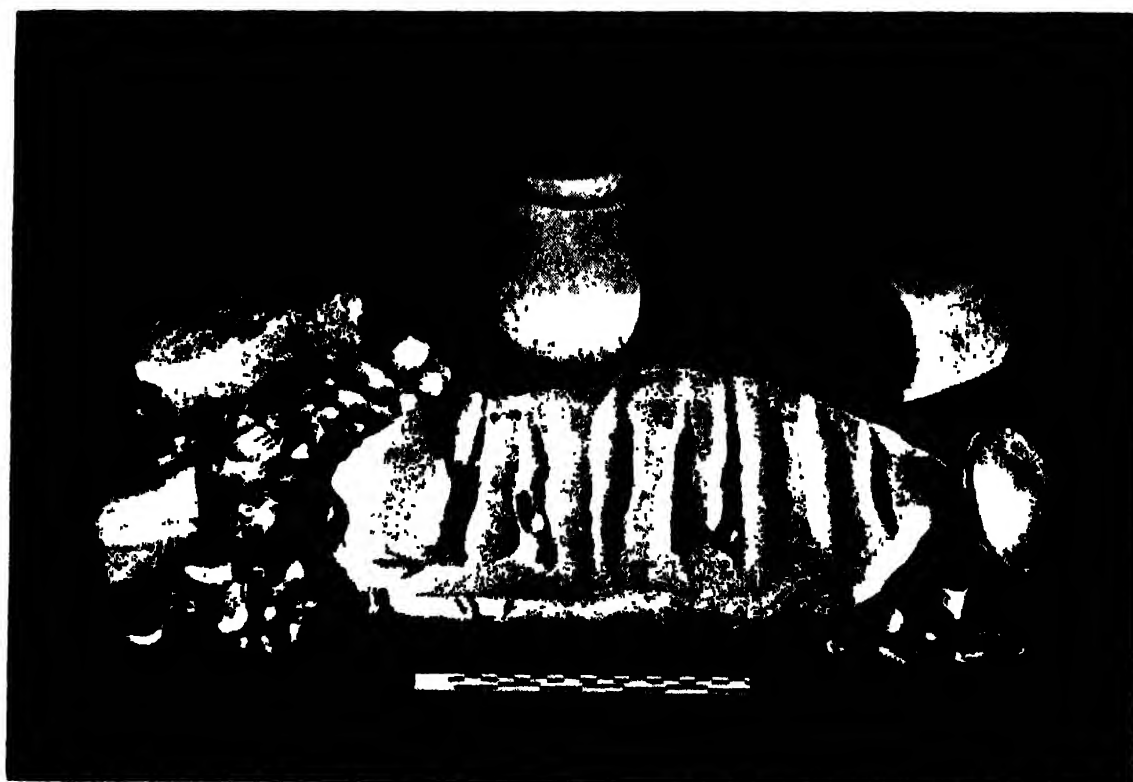
³ The plethora of stone drills, both damaged and intact, at Chanhudaro, and their comparative rarity in ancient Sumer in contrast, led Mackay to think that it was the Indian bead makers (see Mackay: *Chanhudaro Excavations*, 1935-36, American Oriental Series, Vol. 20, p. 212) who anciently manufactured the beads of that land.

harmony to project the past into the present in an apparently continued tradition and recreate the details of one of the oldest industries in the country.¹

¹ I am grateful to Shri A. Ghosh, Director-General of Archaeology in India, for permitting me to publish this paper, and to my numerous colleagues in the Excavations Branch of the Union Department of Archaeology for preparing the drawings and photographs illustrating it.



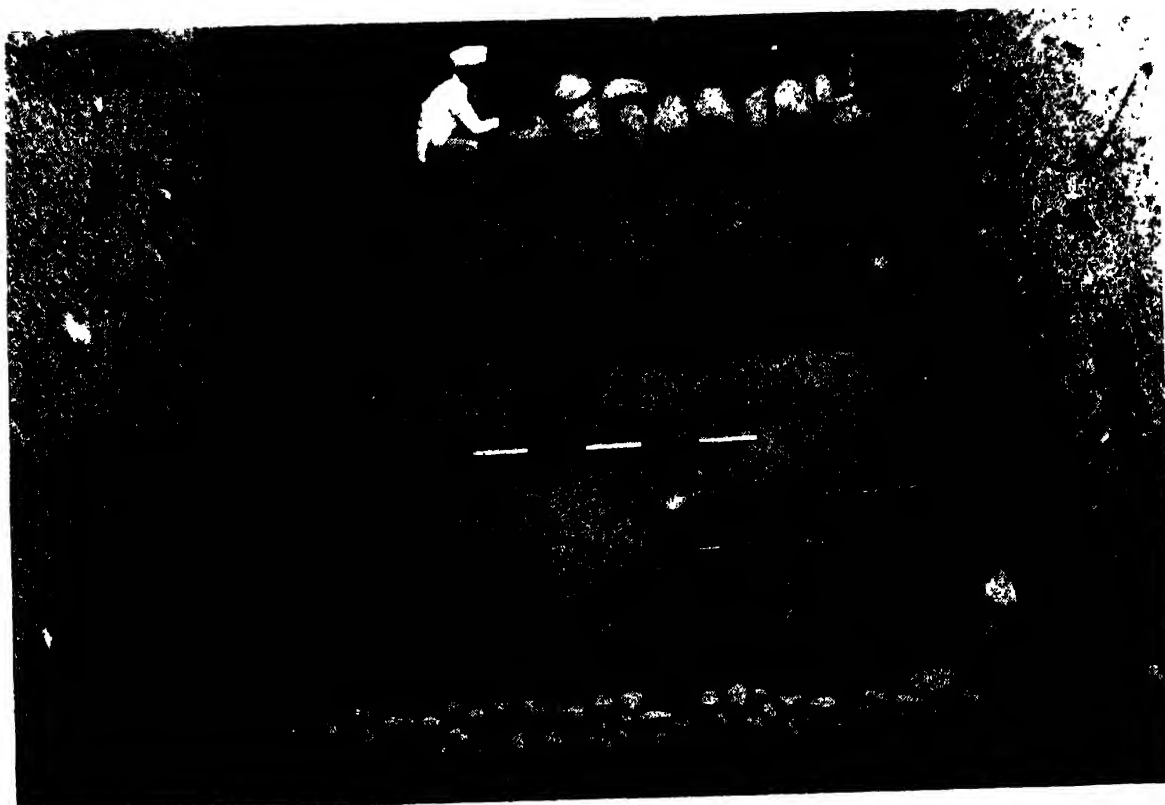
Unfinished disc-shaped ear-ornaments from Ujjain. No. 1 from Period I is the rough outline of a disc, after the flakes have been removed; Nos. 2 and 3, from Period III, are partially finished.



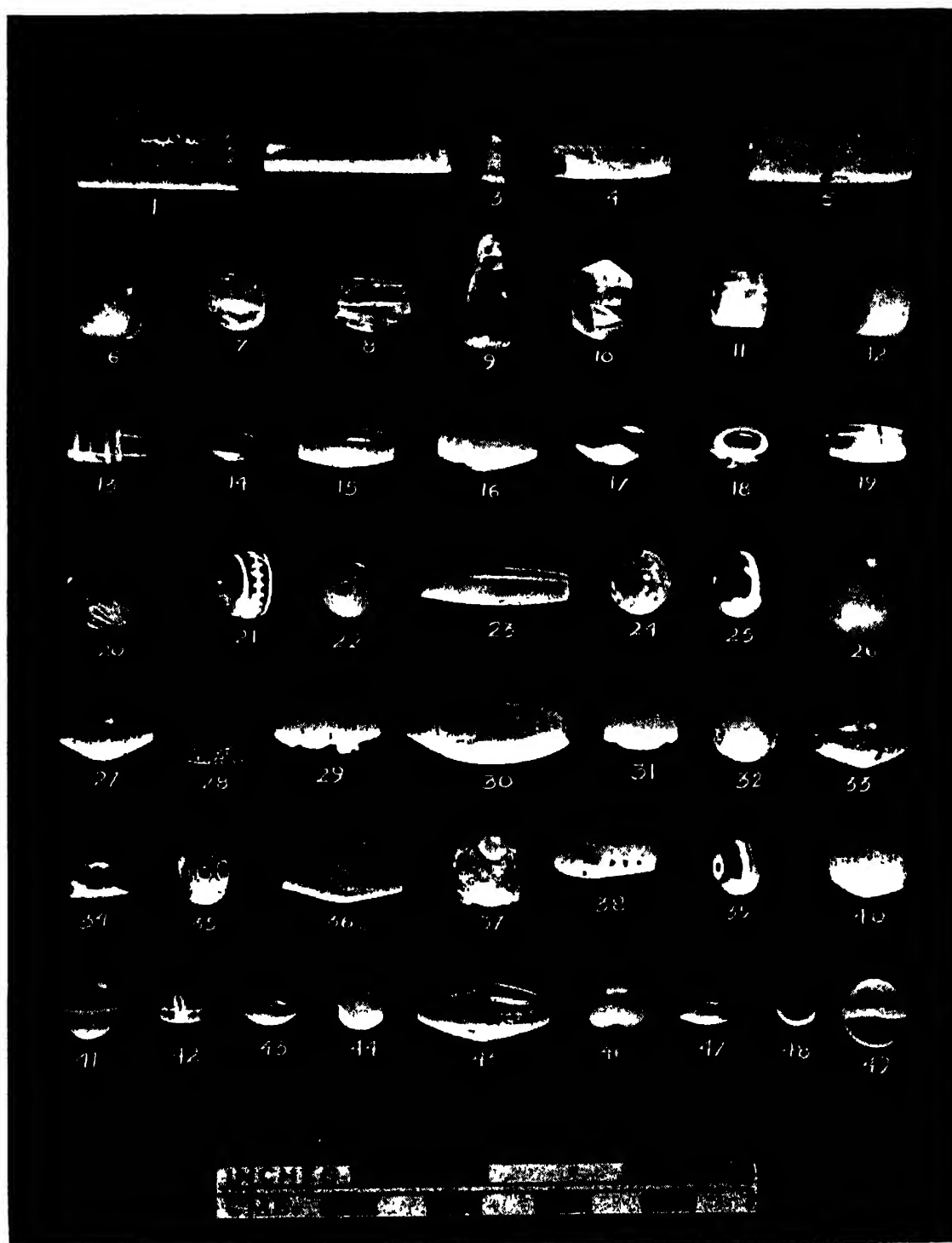
Equipments of the manufacture of beads consisting of (a) raw materials, (b) earthen jar for heating the stones, (c) stone lid to cover the jar during heating, and (d) sandstone grinding slab for grinding and polishing. The grooves on the slab are the result of friction. All these materials are from Ujjain, Period III. Scale of inches and centimetres.



A hoard of unfinished beads from Ujjain, Period III.



Channel ovens for tinting beads from Ujjain, Period III. Scale of feet.



Beads from Ujjain :

No. 34 from Period I.

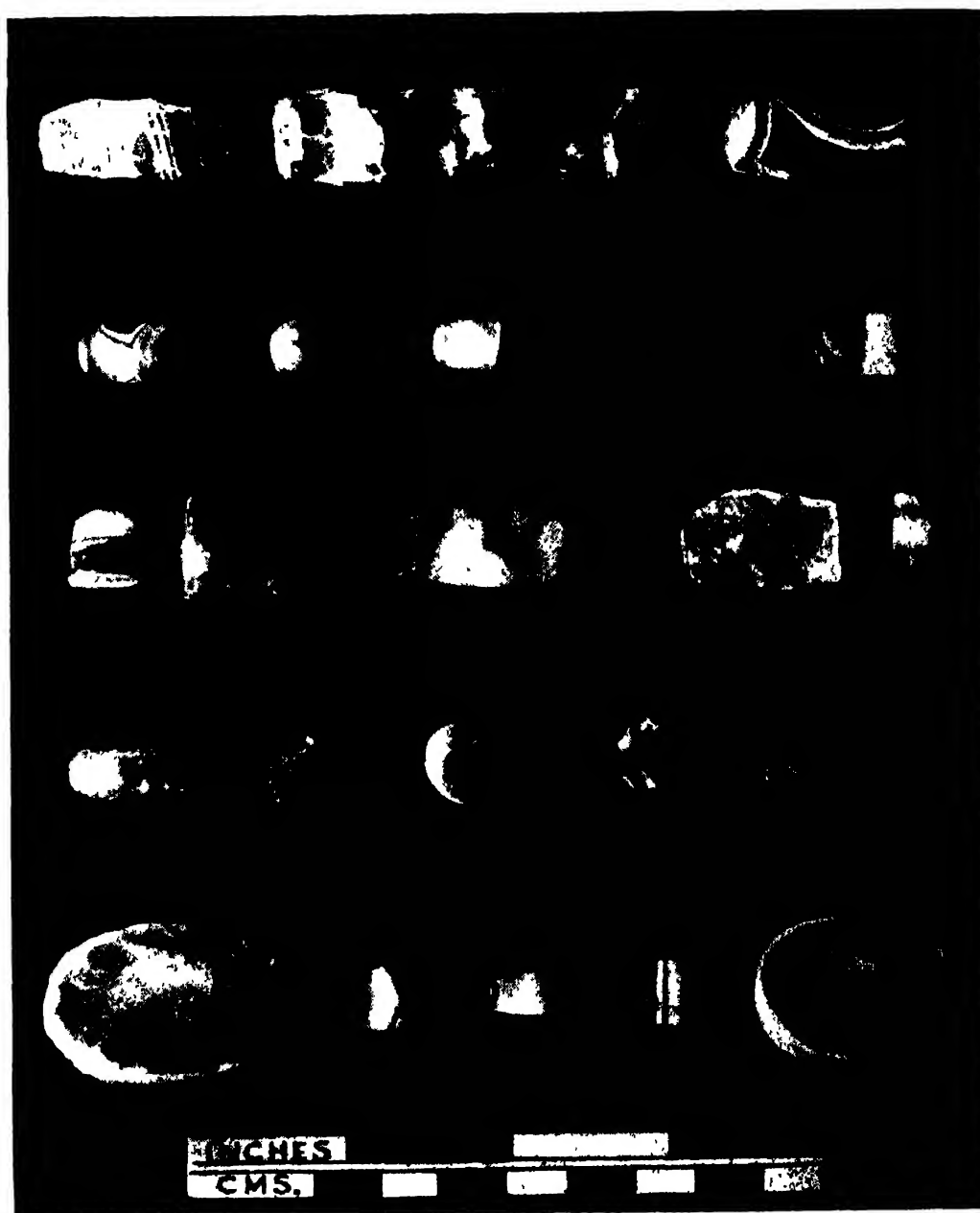
Nos. 2, 3, 7, 10, 14, 15, 17, 22, 29, 30, 33, 35, 40, 41, 43, 44, and 47
from Period II.

Nos. 4, 5, 6, 8, 11, 12, 13, 16, 18, 19, 20, 21, 23, 24, 27, 28, 31, 32,
38, 39, 42, 45, 48, and 49 from Period III.

No. 37 from Period IV.

No. 25, unstratified.

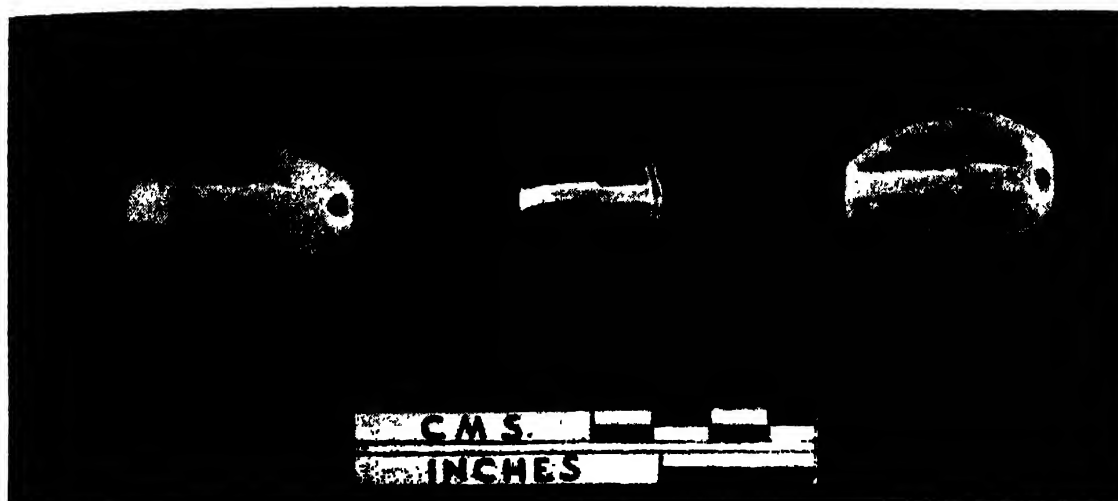
Nos. 1, 9, 26 and 46, surface finds.



Unfinished beads from Ujjain, Period III, showing different shapes.



Semi-finished stone beads from Ujjain, Period III,
showing different shapes.



Finished beads of crystal from Ujjain, Period III, showing that the perforation was made from two ends, and that they often met at an obtuse angle.



Photograph showing the process of detaching flakes from a lump of stone as adopted by the present-day bead makers of Cambay. The iron pike held by the left hand is actually fixed into the earth, and the lump is held against it. The flakes are removed by a horned mallet held in the right hand.



Photograph showing different stages in shaping the rough outlines of bead as per practice obtaining in Cambay today.

REVIEW OF BOOK

TRADITIONAL INDIA: STRUCTURE AND CHANGE. Edited by Milton Singer. Bibliographical and Special Series. Volume X. American Folklore Society, Philadelphia, 1959. xxiii+332.

The book forms an admirable introduction to the traditional culture of India and also to the processes of change to which that culture has been subjected in modern times.

There are altogether nineteen articles with a preface by the Editor. These are arranged in three sections, namely the Social Organization of Tradition, Cultural Performances and Cultural Media and Some Problems and Processes of Culture Change. In the first section, the traditions of the Brahmin, Kshatriya, Vaishya and of a caste of genealogists have been presented by various authors from different parts of India. In the second, several contributors have presented some of the mechanisms by means of which traditions are transmitted either in rural or in urban India. In the third section, we are told how the traditional culture or cultures of India are being subjected to modification under the stress of contemporary life.

All the articles are based on personal observation or experience. And the Editor deserves congratulation on the success with which he has succeeded in combining them into something which has the consistency of good architecture. Naturally, the picture which has thus emerged does not represent all that is happening in traditional Indian culture today, nor does the book claim to do so. But certainly the picture presented is a correct one. Moreover, one feels stimulated; and this is perhaps a conspicuous mark of its success.

NIRMAL KUMAR BOSE

Jl. As. Soc., Vol. I, No. 2, 1959.

BIBLIOGRAPHICAL SUPPLEMENT

BIBLIOGRAPHY OF TIBETAN STUDIES **Being a record of printed publications mainly in** **European Languages**

By
SIBADAS CHAUDHURI

[Continued from Jl. As. Soc., Vol. I, No. 1, 1959.
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ARMENIAN HERO-LEGENDS, AND THE EPIC OF DAVID OF
SASUN¹

By SUNITI KUMAR CHATTERJI

(Paper received on 11th November, 1960)

A. THE ARMENIAN PEOPLE—THEIR LANGUAGE AND OLD LITERATURE,
AND THEIR OLD RELIGION

The Armenians are one of the most remarkable peoples of the world. They are now concentrated in the Soviet Republic of Armenia to the south of the Caucasus Mountains, where they number near about 2 millions. But the Armenian people, who originally had their home in present-day Armenia as well as in considerable parts of Eastern Asia Minor and North-Western Iran, are now largely a scattered people, large numbers of Armenians being found in Turkey, Syria and Lebanon and in Iran, and groups of them are found also in other States of the Soviet Union, as well as in the United States. There are settled Armenian communities in other countries of the Near East and the Far East, and even in Indonesia and Australia. In India we have a settled population of Armenians who number between a thousand and fifteen hundred, and they are mostly Indian citizens. Armenian merchants began to come and settle in India from the sixteenth century, and as an intelligent and culturally advanced people they have always participated in the affairs of the country of their adoption. They took to English education and joined Indian Universities, and the University of Calcutta has given a place in its curriculum to both Classical Armenian as a language equivalent to Sanskrit, Latin, Greek and Arabic, and to Modern Armenian as the mother tongue of an influential Indian minority community. The total number of Armenians all over the world, however, would not exceed 4 millions now.

But at one time, in the early centuries of the Christian era, and even before that, the Armenians were quite a powerful people in the Near East. There are two important points of contact between the Armenians and the people of India. In the first instance, there is an Armenian section or group in the population of India. Secondly, the Armenians speak a language, which being a speech of the Indo-European family, is related to Sanskrit (and to Modern Indian Sanskritic languages like Hindustani, Bengali, Marathi, Panjabi, etc.) as well as to Old Iranian (with Persian, etc.) on the one hand, and to Greek and Latin as well as to Germanic, Celtic and Slav languages on the other.

The Armenians are a very much mixed people, like many other nations, and they consist of certain basic peoples who lived in and around present-day Armenia from the end of the second millennium B.C., like the Urartu people and other allied nations of antiquity, of whose culture there are plentiful survivals in the life and culture of the Armenians. It would appear that branches of the same ancient race, to whom the 'Caucasian' peoples

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like the Georgians and others belong, namely, tribes like the Hayasa and the Armens, gave the bases for the formation of the present-day Armenian people, like the Dravidians and Austriacs in India. They were overlaid by other races from Asia Minor (the so-called Asianic peoples), from Syria and Assyria (pure or mixed Semites) and from Iran (pre-Aryan peoples of Iran, to start with, and then the Aryans). Then, from about 3,000 years from now, Indo-European speaking peoples, kinsmen of the Aryans of Iran and India, came and settled in Armenia, and furnished large and culturally very important elements to form the present-day Armenian nation.

The original culture of the Armenians was from the very beginning a very mixed one, as the people were largely the result of miscegenation. But finally it was the *language* of the Aryans which prevailed, and this became later on, some time probably by the middle of the first millennium B.C., what may be called the Proto-Armenian speech. Specimens of this speech have not been preserved, except, perhaps, in some personal and topographical names which have been found in ancient documents in other languages. This Proto-Armenian speech was profoundly modified in its formative period by the earlier languages of the area, including of course the basic language which was allied to Georgian.

It was during the fifth century A.D. that we have the beginnings of Armenian literature. This literature was started under Christian inspiration after the Armenians as a people became Christians. The Bible was translated into Armenian (during the first half of the fifth century, jointly by Saint Sahak Parthev or Isaac the Parthian, who died in A.D. 439, and Mesrob Mashtots, and their followers). Armenian scholars then began to write about their own history and traditions, under Biblical and Greek inspiration. Besides, they began also to translate books from the Greek. In this way, Christian Armenian literature started. But there were current among the Armenians a considerable mass of oral literature relating to their Gods and their heroes and also their kings and wise men, in addition to a popular literature of songs relating to love and life such as is found all over the world. A good deal of it must be very ancient, although the oldest written Armenian literature goes back to the fifth century A.D. In addition to Christian literature, some meagre fragments of pre-Christian poems and songs and epic stories have been preserved, and these form very precious specimens of the pre-Christian literature of the Armenian people prior to the fifth century A.D.

Armenian received its own alphabet early in the fifth century, when Mesrob Mashtots, a monk, evolved a script for his mother tongue following the principle of the Greek alphabet, and he invented letters for all the sounds of Armenian as they were current in his day. This shows a fine scientific analysis of the phonetics of Old Armenian. Mesrob would appear to have perfected or completed the Armenian alphabet, and the beginnings of it can very well go back to the fourth century A.D., or even earlier.

The Old Armenian speech of the fifth century, or Classical Armenian as it is called in English, continued down to about the eleventh century A.D. Classical Armenian or Old Armenian is known to the Armenians as *Grabar* (i.e. 'Book Language', from Armenian *gir* 'book' and *abar*, an adverbial ending). From the eleventh century, as a natural transformation of Old Armenian, what may be called Middle Armenian began to come into use slowly; and excepting in some religious writings, the old Grabar or classical language was not much used by the masses, and following the masses by ordinary writers too. Later forms of this Middle Armenian developed into the various spoken dialects of Armenian which are current at the present

day. In modern times, these dialects ranged round two types of literary speech, one based on the Ararat or Eastern dialects, and the other on the Constantinople or Western dialects. In the nineteenth century, these two forms of Modern Armenian became established, and both are known as *Ashkharhabar* or 'the People's Speech'. The Eastern is the more conservative form of Armenian, and it preserves more or less intact the sound-system of Grabar or Classical Armenian. But in the Western form, what was originally *g*, *d* and *b* became unvoiced to *k*, *t* and *p*, and original *k*, *t*, *p* have become voiced *g*, *d*, *b*, respectively, and there were other phonetic changes also.

Everywhere the Indo-European peoples have built up great sagas or epic and romantic story-cycles. The greatest story-cycles in the world are the creation of the Indo-European peoples. We have of course to mention certain non-Indo-European sagas or stories, such as, for example, those which developed among the Mesopotamian peoples (the saga of Gilgamesh and the myths of Inanna or Ishtar and Dumuzi or Tammuz, and of Marduk), among the Jews (the stories about Abraham and his sons, about Moses, about David and Solomon, and about the later heroes like Judas Maccabaeus), among the Tibetans (the saga of King Gesar of Gling and his wife Hbrugmo and the King of Hor), among the Finns and Esths (the *Kalevala* and the *Kalevipoeg* stories respectively), among the Turks and Mongols (the saga of Oghuz Qagan, and of Chingis Qagan or Jengiz Khan as well as of Jangar, respectively), and among Polynesians (the story of Maui, for instance). But the contribution of the Indo-European speaking peoples in this matter has been unique and immense, when we consider the vast mass of myths and legends and heroic as well as romantic tales of the peoples of India which expressed itself through Sanskrit primarily (as in the *Mahābhārata* and the *Purāṇas* as well as the *Rāmāyana*, and later cycles of romantic stories), of Iran (as in the Persian *Shāh-nāmah* and in fragmentary forms in the *Avesta*), of ancient Greece (as in the Homeric Epics and Greek Myths of Gods and Heroes), of the Germanic world (the saga cycles of Sigurd and Brynhild and the Nibelungs and of Weland and Beowulf and Waldhere and other heroes), and the Celts (as in the Old Irish and Gaelic saga cycles relating to Cuchullain and his group as well as to Finn and his band, besides the Old Welsh stories about King Arthur, which became such an important source of Western European myth and legend in mediaeval times), and also of Slav peoples (though to a much lesser extent). The ancient Armenians had also developed their cycles of myths and heroic legends, but, as said before, these have not been properly preserved. Nevertheless, there are enough indications of a rich series of mythic and heroic stories having been current among this branch of Indo-European speaking people. These fragments have been culled from early Armenian literature, and in some cases these epic stories have been found to be preserved to our day in popular ballads relating to the national heroes of the Armenian people.

In ancient Armenian religion we find a conglomeration of different religions which came from Iran, from the Semitic world, from the Hellenic world and also from the earlier Caucasian world itself. The Indo-European speaking people, who supplied the language to the Armenians as a composite nation, had their own and original legends, which we find partially preserved among the ancient Indian Aryans, the Iranians, the Greeks, the Slavs, the Germans and the Celts. But precious little of these has been preserved in the Armenian world. Armenian myths and legends as they have survived now are very largely of Iranian inspiration, with certain elements added from the world of Assyrio-Babylonians and of the Greeks.

Some ancient pre-Indo-European elements also appear to be there. After the adoption of Christianity, Jewish myth and legend as in the Old Testament came to be engrafted on this composite mythology and hero-tales of the Armenian people. It would be quite a task to unravel satisfactorily all the various strands which went to make up the very complex mythic and heroic world of Armenia of pre-Christian as well as Christian times.

There have been occasional attempts to cut out a path through this tangle of myths and legends of diverse peoples which have commingled to form the myths and legends and hero-tales of the Armenians, but there is as yet the lack of a satisfactory work in any language on this matter. Joseph Karst of the University of Strasbourg brought out (1948, Editions P. H. Heitz, Strasbourg and Zurich) his 400-page work in French (*Mythologie Armeno-Caucasienne et Hétito-Asianique: Répertoire des Antiques Religions de l'Asie Antérieure Septentrionale, comparée avec le Pantheon Chamito-Sémitique, Pélasgo-Égéen et Hespéro-Atlantique*), and although there are in it some important bits of information and suggestive observations, as the full title indicates, the work is far wide of the mark and goes off at a tangent; and in spite of an attempt to classify the Armenian mythological and legendary elements into 'Armenian', 'Alarodo-Urartian' or 'Chaldaic-Alarodian' and 'Georgian', the resultant picture does not give a clear representation of the situation, whether historical or in actuality.

Yet from the fragments that we can see, Armenia presents a rich storehouse of ancient myth and hero-saga. It is a matter of great satisfaction that at the present day the Armenians, who are a very cultured people, are becoming once more alive to this great national heritage of theirs, and the memory of these stories is being kept up, and is also being revived. Children at school are taught this national heritage, and Armenian scholars and literary men, as well as those who are engaged in research into the history of their past, are collecting and salvaging such relics of old Armenian myths and stories and traditions as well as of oral literature as are still surviving.

One thing has to be specially noted in connection with the development of Armenian history and the fortunes of the Armenian people. The geographical factor has a very great importance in the life and history of a people. Some peoples have been more or less cut off from their neighbours and from the rest of the world, and they have grown in isolation, drawing out to the fullest the qualities of their mind and their social *milieu*; and when they could peacefully assimilate in their isolation things of high cultural value from more advanced peoples, their own cultural development has been distinctive and valuable. The Japanese are a conspicuous example of such a people. Originating in prehistoric times from a mixture of an East Siberian people (from whom come the Koreans, the Ainus of Japan, and the Kamchadal, the Yukhagir, the Gilyak and other peoples) and the Indonesian or Malay race, later influences from Korea and China, and indirectly from India, moulded the mind and culture of Japan which could then present itself as a most beautiful culture-complex in the world, with the full individuality of the Yamato or Japanese 'race' as its basis. The Early Celts, the Early Germans and the Early Slavs form other instances of peoples growing in isolation but influenced profoundly by foreign cultures, if not by large-scale mixture in blood with other races. Through racial miscegenation, with attendant cultural mixture, and under the domination of the Indo-European people in the linguistic and organizational side, the Ancient Greeks and the Ancient Hindus of India came into being. But there were some other peoples who, because of their geographical situation, could not be left to themselves for any length of time. Their countries

formed highways, so to say, of the migrating and conquering peoples from all sides, and so they were never left in peace. Egypt is one such country. Armenia is another. The country by virtue of its position had to become the cockpit for fighting nations. This constant contact with hostile peoples prevented a peaceful, continuous and balanced development of the racial and cultural bases of Armenia. So there is no wonder that in their language and their religion, in their myths and legends as part of their culture, as much in their blood, the people of Armenia would present a most remarkable mixture. Their geographical situation has brought to the Armenian people, particularly during the last thousand or fifteen hundred years, untold sufferings at the hands of ruthless conquerors who would never let them be in peace. The dispersal of the Armenian people, and in recent years attempts at genocide to wipe out the Armenians in their homeland (or in lands where they became through forces of history a minority population), have been their evil fate, in a different way from that of the Jews.

This has to be borne in mind when we study the Armenian people—their culture, their religion and their myths and heroic epics. The resistance given by the Armenians as a people to all these foreign invaders, conquerors and oppressors forms one of the bases and backgrounds of some of their hero-sagas. For, all through the centuries, they had to wage desperate wars against invaders like the Assyrians, the Asianic peoples, the Syrians, the ancient Persians, the Parthians, the early Greeks, the Romans, the later Greeks of the Byzantine Empire, the Arabs, the Kurds, the Crusading Frenchmen and others, the Mongols, and finally the Turks; and in this struggle to hold their own, through all the period of their life as a nation, the Armenians were marked by a conspicuous patriotism and gallantry, sustained, in the latest phase of their history, by their Christian faith. The final shaping of what may be called the national epic of the Christian Armenian people, the epic of David of Sasun, which goes back in some of its episodes to the pre-Christian periods of Armenian history, has been in this Christian nationalistic atmosphere, which became for the Armenians a heritage too precious to lose.

B. EARLY MYTHS AND LEGENDS OF ARMENIA

The original religion of one section of the Armenians, the pre-Indo-European peoples of the area, would appear to be closely connected with the religion of ancient Babylon. It centres round the worship of a great Mother-Goddess, who was a powerful Deity, and who, like Nature herself whom she typified, was beautiful and loving and at the same time cruel and heartless. Everything owed its origin to her, and nothing was more powerful in the universe than this Mother-Goddess. Of course, in the early Babylonian pantheon there were other great Gods, but the Mother-Goddess continued to have her special position of importance. She was known to the Sumerians, the pre-Semitic founders of the civilization of Mesopotamia, as Inanna, and her male counterpart was known as Dumuzi. The story of her relations with Dumuzi survives in the Greek legend of Aphroditē and Adonis. The great Mother-Goddess loved this young Dumuzi, but he would die every year at the beginning of winter, and the Mother-Goddess, and with her the whole world, would go into mourning over this tragedy. But Dumuzi was really the Sun-God; and the Sun would lose his strength and vigour—almost his very life—during winter, and he would be once again restored to life in spring. This nature-myth was quite a persistent one, and in later Babylonian religion where this myth lived on, we find that Inanna was simply transformed into the great Goddess Ishtar,

and Dumuzi became Tammuz. Tammuz was known by one of his Semitic appellations as Adonai, which meant 'My Lord', and this Semitic epithet is the source of the Greek name Adonis. The name Inanna survived also as Nané. The Mother-Goddess was a personality with many characters and many names, and just as Artemis and Aphroditē in Greek religion were sometimes identified with each other, and sometimes were in sharp contrast with each other, so also the various emanations or forms of the great Mother-Goddess were conceived as separate deities, each with an individual personality.

The Armenians, during the first millennium B.C., obtained many new religious ideas and numerous myths, largely from their Iranian as well as Semitic neighbours; and later on, after their close contact with the Greek and Roman worlds, their ideas were also modified by the Greeks and the Romans.

In Iranian religion, the old Gods and Goddesses with their individual names and characters were universally worshipped, and this phase of Iranian religion is illustrated in the Yasht section of the *Avesta*, the sacred literature of the ancient Iranians. These Yashts in spirit correspond to the Vedic hymns, as in this Yasht section we get a portrayal of the various Iranian divinities who form members of a polytheistic pantheon—divinities like Mithra, Tishtrya, Verethraghna, Sraosha, Hvare or Hvare-Khshaēta, as well as Goddesses like Ardivi Sūra Anāhita and Haurvatāt and Ameretāt. Zarathushtra came before the sixth century B.C., and by his insistence upon the worship of the One True God, Ahura-Mazda, put all the lesser Iranian Gods and Goddesses in the shade. He preached his conception of Dualism, in which good and evil, typified by Ahura-Mazda and his heavenly hosts on the one hand, and by Angra-Mainyu, the force of evil, and his demons on the other, were in an eternal conflict. Some abstractions conceived by Zarathushtra, to indicate some of the forces working on the side of Ahura-Mazda, took up the garb of living divinities (like Spenta Armaitis, Vohu-Mano, Asha-Vahishta or Arta-Vahishta). The Armenians took over the earlier Gods and Goddesses of Iran, including the great Mother-Goddess of the Mesopotamians, as well as some of the specific Zarathushtrian conceptions, like Ahura-Mazda himself and some of his attendant forces, who were conceived as divinities. In this way we have before the Christian era the formation of a complex Armenian pantheon.

This old Armenian pantheon may be derivative, but it was none the less powerful in the life of the people. The ancient Persians were averse to image worship. But the example of the Assyrio-Babylonians, and then of the Greeks and Romans, was too strong for the Armenians, and they also began to form images of these Iranian divinities, whom they adopted, although in a much modified form. The chief deities of the Armenians were the three:

Aramazd—Iranian Ahura-Mazda;

Anahit—The Goddess Anāhita of Iran, related to the Babylonian Inanna or Ishtar; and

Vahagn—Iranian Verethraghna (*Vərəθraγna*, Indo-Aryan *Vrtraghna*); and sometimes Mihr or Mithra took the place of Vahagn.

Aramazd lost all his sovereign importance as the Only True God which he had in Iran as Ahura-Mazda, after he was adopted by the Armenians. He became just a Chief God, and a God of Heaven. Anahit, who was extolled in pre-Christian times by the Armenian kings as 'the great lady, the glory of our nation', was the Vivifier, and further was looked upon as Mother of all Chastity. She was considered to be a daughter of Aramazd.

Vahagn became a sort of National God with the Armenians. He was the God of Victory and was in effect a God of Valour and Manliness. He was associated with the Thunder, and was also identified with the Sun-God, with whom Mihr or Mithra was also connected. He was the Slayer of Dragons, like the Indo-Aryan Indra Vṛtraghna and the Babylonian Marduk. In later times, the Greeks identified Vahagn with Hēraklēs. The solar connection of Vahagn is found in a pre-Christian pagan song which the ancient Historian of Armenia, Movses Khorenatsi (Moses of Khoren, according to tradition born A.D. 410, but really his *floruit* comes down to the sixth or seventh century, because of the very great Greek influence in the writings ascribed to him), has given in his book. It runs thus:¹

erkner erkin ev erkir ;
 erkner ev tsirani tsov.
 erkn i tsovoun ounēr
 ev zkarmrik el'egnikn.
 ǽnd el'egan phol', tsoux elanēr,
 ǽnd el'egan phol', botsh elanēr,
 ev i botshoyn patanekik vazēr.
 na hour her ounēr,
 apa thē botsh ounēr morous,
 ev ačhkounkhn ēin aregakounkh.

'In travail were heaven and earth,
 In travail, too, the purple sea !
 The travail held in the sea
 The small red reed.
 Through the hollow of the stalk came forth smoke,
 Through the hollow of the stalk came forth flame,
 And out of the flame the little boy ran !
 Fiery hair had he,
 Ay, too, he had flaming beard,
 And his eyes, they were as suns !'

The above song or poem used to be sung to the accompaniment of the harp by bards in some places in Armenia, long after the establishment of

¹ I am quoting the original Old or Classical texts of this and a few other fragments of pre-Christian Armenian poetry preserved by Moses of Khoren and others to give an idea of the nature of Old Armenian as an Indo-European speech. In the Roman transliteration adopted, the pronunciation of Grabar or Old Armenian is followed. The following points are to be noted in the sound-system of Old Armenian, which was as follows:

Vowels: a, e, i, o, u (written as ov = ou), ū (written iv = iu), ǽ, ē, ō.

Consonants: p, ph, b, m ; t, th, d, n ; k, kh, g ; x, h ;

č, čh, j ; ts, tsh, dz ; š, ž ; s, z ; v, y ; l, l' ; r, r'.

Of the above sounds, x is the guttural unvoiced spirant, the sound of the Persian and Arabic letter خ, and German ch ; č, čh, j are like English ch, chh (as in *Birch Hill*) and j ; ts is like *ts* in English *wits*, tsh as in English *meets him*, dz as in English *adze* ; š has the sound of English *sh* in *shall, should* ; ž that of English *s* in *pleasure* (= pležar) ; l' is a velar or guttural l, like l^w, and this sound of l' of Classical Armenian later became gh spirant (like Modern Paris French r, Modern Greek γ, and Arabic غ) in the Modern pronunciation of Armenian ; and r' is a strongly trilled r, like rr. The value of ǽ is like that of unaccented a in English as in *ago, Russia* (= ǽgou, rašǽ). Initial e and o are pronounced as ye and vo. It should be noted that in the Armenian alphabet, ph, th, kh, čh, ts, tsh, dz, l' and r' are represented by single letters.

Christianity in the country. Vahagn's wife was Astl'ik (in later pronunciation Astghik), a daughter of Aramazd.

The Iranian Mithra, in Pahlavi Mihr, was also adopted by the Armenians, as the Sun-God *par excellence*; and Mihr became quite a popular divinity.

Then we have Tiur or Tir, another God from the Iranian pantheon (Tishtrya in Old Iranian, Tir in Middle Iranian). Tishtrya among the Persians is the Leader of the Stars against the Planets, as Stars and Planets belong, respectively, to the worlds of Ahura-Mazda (the Supreme Divinity) and Angra-Mainyu (the Spirit of Evil). Tishtrya was identified with the star Sirius, and he fights against the Demon of Drought and conquers him in the end. He brought rain regularly to the people. But among the Armenians, Tir became a God of Oracles and of Dreams, and was a Defender of Arts and Letters. Later he was identified with both Apollo and Hermēs of the Greek pantheon. He was called also the Scribe (*Grol'* or Grogh) of Aramazd; as such he had the task of registering when a man was about to die. In this sense, he survives even now in Armenian folk-lore.

The Iranian Spenta-Ārmaiti (or Holy Faith) became in Armenian Sandramet. In the *Avesta*, Spenta-Ārmaiti was a daughter of Ahura-Mazda and became typified as the Virtuous Woman, and was looked upon as the Divinity of Piety and Modesty. But in Armenia, Spantramet or Sandramet was first changed into the Goddess of the Earth and of Hades, and became the wife of Aramazd; and finally there was a total transformation when she became a male God, and as such Sandramet was looked upon as a God of Hell who also presided over nightly drinking bouts. Thus only his name was taken over from Iranian, and the God Sandramet himself would appear to represent an earlier Armenian pagan deity analogous to the Greek Dionysos, or Bacchos, the God of Wine and of Divine Ecstasy.

The Armenians also worshipped deities of Syrian origin. One was a Barshamin, a Divinity connected with the Sun, like Mihr and Vahagn. This name in Semitic is *Ba'al-Shamim* or 'the Lord of Heaven'. Nané, of course, was the great Mother-Goddess, whose name probably goes back to the Sumerian Inanna, as said before. (Nané as a form of the Mother-Goddess of the Near East still survives in the name Nānī given to the Goddess as worshipped in the shrine of Hinglāj in Balochistan, where every year Hindu pilgrims from all parts of India would assemble after an arduous journey—the Hindus have rightly identified Nānī of Hinglāj with Umā or Durgā, the great Mother-Goddess, the spouse of Śiva in Hindu pantheon, although the shrine is in charge of a priest who is looked upon as a Muslim *fakir* or religious mendicant.)

There is a Nature Goddess of Syrian origin known as Astl'ik, the name in Armenian signifying 'Little Star'. The name *Astl'ik* may come from, or at least may have been influenced by, the Syrian name *Astarte*. She was the Goddess of Love, like the Greek Aphroditē. The rose among the flowers and the dove among the birds were her special symbols, as in the case of the Greek Goddess also. She was also looked upon as the Goddess of the Moon. She became connected with Aramazd as his daughter. The Festival of Roses—the *Vardavar*—was celebrated in honour of Astl'ik at the beginning of summer. The conception of Astl'ik evidently was also influenced by the poetry of Greek mythology. Astl'ik was in the habit of taking a bath in a stream every night, and to prevent impious Peeping Toms, who wanted to look at the Goddess in her naked beauty (this suggests the Greek myth of Artemis surprised in her bath by the hunter Aktaiōn, who was transformed into a stag and killed by his own dogs for this impiety), Astl'ik created mist to cover up the area where she would be taking her bath. Her lover and

husband was Vahagn, and the Iranian Vahagn and the Semitic Astl'ik formed the popular Young and Romantic Husband and Wife Deities of ancient Armenia.

Very little indeed of the original Indo-European religious notions and legends survived among the Armenians. After they became Christians, they sometimes brought in the ideology of the Bible, and tried their best to synchronize their past history and legends with the Hebrew legends as in the Old Testament. But the Iranian influence appears to be dominant all through in Old Armenian religion, as in the Armenian language. Also some of the myths from the Mesopotamian world were adopted by them.

There is mention in the *Avesta* (in the Yasht dealing with Ardvī Sūrā Anāhita, the Great Goddess as the Goddess of the Waters) of Asha-vazdah (or Arta-vazdah, in Old Persian), who was an immortal fighting the Dānuš and other non-Aryan tribes of Iran. He is, according to the *Avesta*, sleeping for ever, and he will wake from his sleep and reorganize the world.

There is also the Iranian myth of Thraētaona (in the *Shāh-nāmah* Farīdūn), who fought with Azhi-dahāka or the Demon-like Dragon (in the *Shāh-nāmah* he became transformed into the evil king Zohāk). After his defeat at the hands of Thraētaona, Azhi-dahāka was enchained in a cave in the Elburz Mountains by his victor, and there Azhi-dahāka remains chained for ever. There is an old Armenian version of the story. It would appear that these two stories, one about the undying Asha-vazdah (or Arta-vazdah), who is waiting to rise from his sleep to reorganize the world, and the other about the evil dragon Azhi-dahāka, who is for ever chained within a cave in the Elburz Mountains, have combined to give rise to the Armenian legend of King Artavazd, the son of King Artashes, who is in chains within a mountain cave, waiting to come out to effect great changes in the world, which will not be for the good of man. As a matter of fact, the legend of a Giant or Titan being chained to a mountain would appear to be an ancient Caucasian legend which originated among the pre-Indo-European peoples of the area, and this passed on to the Iranians and Armenians on the one hand, and to the Hellenes or ancient Greeks on the other (as in the legend of chaining Prometheus the Titan to the Caucasus).

There is evidence of Indian religions (Buddhism and Brahmanism) reaching Armenia in pre-Christian centuries. An Indian colony which was settled in Armenia in the second century B.C. for generations preserved its religion, until finally it was forced, early in the fourth century A.D., to accept Christianity, when it became the national religion of the Armenians (by 301 A.D.). An Indian deity called Gisaneh (Kṛishṇa?) was actually worshipped in Armenia. We know that Krishna Vāsudeva as an incarnation of Vishnu or God as Preserver was worshipped in India in the second century B.C., when the Greek ambassador Heliodoros, from the court of Antialcidas, the Greek king of Taxila, to the court of king Bhāgabhadra of Mālava, declared himself to be a follower of Vishṇu and erected a temple in honour of Vāsudeva or Kṛishṇa at Vidiśā in Mālava. In Armenia, Gisaneh's image and his temple were destroyed under orders of Saint Gregory in the fourth century. The priests of Gisaneh were dark Indians who wore long hair, and they were most faithfully devoted to their God. They resisted enforced Christianization to the last.

C. SOME ANCIENT ARMENIAN HERO-LEGENDS

A very ancient hero of Armenia is the eponymous *Nahapet* or chief of a clan, Haik. An Armenian is known in his own language as *Hai* (in plural the word is *Haikh*). The word is really the Indo-European **potis* = Greek

posis, Sanskrit *patiḥ*, meaning 'lord' or 'master', which became *hai* in Old Armenian, with regular change of *p* to *h* and loss of intervocal *t*. Haik as a national hero evidently was a creation for patriotic reasons from the national name. Here the story is mingled with Biblical legends. Haik fought with Bel or Belus, who was identified with Nimrod of the Hebrew Book of Genesis. Haik defeated Bel and killed him in battle, and freed the Armenians from these Semitic invaders, and re-established Armenian independence.

Another very old legend of Armenia is that of the Armenian *Nahapet*, Ara the handsome. He was loved by Queen Shamiram, who has been identified with Semiramis, the Queen of Assyria, and the wife of Ninus, the founder of Nineveh, according to classical stories based on Babylonian legends. But Shamiram would appear to be just an ancient Armenian transformation of the Babylonian Goddess Ishtar, the heartless Goddess of Love and Pleasure. It is said that Shamiram loved Ara, and wanted him to be her lover. But Ara, who was a loyal husband, refused to leave his wife Novart. Shamiram sent an army against Ara, and Ara was killed in the fight. She lamented over Ara when his dead body was brought to her, like Ishtar lamenting over Tammuz or Aphroditē lamenting over Adonis. Legends also say that Ara was sought by Shamiram to be restored to life by some genii who licked his wounds. Ara could not come to life, and Shamiram made one of her young lovers dress like Ara and personate him. This is a reminiscence of the annual coming to life of Tammuz, to be once again the lover of Ishtar for the rest of the year.

From very early times we therefore note this story as a common *motif* in Armenian national legends, of Armenia being invaded and conquered and ruled over by oppressive foreigners, and the country being ultimately liberated by national heroes.

D. THE EPIC STORY OF KING ARTASHES AND QUEEN SATHENIK AND THEIR SON KING ARTAVAZD

There were in Armenian history two kings named Artashes—one was Artashes I, who lived in the second century B.C., and the other was Artashes II, who lived in the first century B.C. It is not known to which of these two kings the heroic and romantic tales relating to King Artashes really refer. But it seems that it was the first Artashes of the second century B.C., who is the original hero. He is said to have ruled from 190 to 159 B.C. His name is Iranian (with the common element *Arta* of Old Persian, which is *Asha* in the Avesta dialect, and which is the same word as the Sanskrit *Rta*, meaning 'Eternal Law, or Ultimate Truth'); and in Greek, this name has been modified into Artaxias. The original story about Artashes of the second century B.C. appears to have been enlarged in the first century A.D. during the rule of the great Armenian king Trdat (or Tiridatēs, the First), who ruled over Armenia as a king of Parthian origin.

Artashes was looked upon as one of the great historical heroes of Armenia. Moses of Khoren, the great Armenian historian (mentioned before), has told us how in his time the deeds of King Artashes were chanted in certain parts of Armenia by bards in epic songs. It is tantalizing for us that these epic songs have not been wholly preserved by any early Armenian writer, excepting that, through a stroke of good fortune, we have a few fragments quoted by Moses himself. They give us some idea of the story, and this is interesting as what may be described as the first national epic story among the Armenian people. Like most epic stories, the exact period when the hero and his cycle flourished is not known, but, as said before, it

probably goes back to the second century B.C. Subsequent fights between the Romans and the Armenians have also had some influence in the evolution of this story. Along with the story of Artashes, that of his son King Artavast goes as a pendant.

The story of Artashes is given below. The narrative has been given in a very short form by Vahan M. Kurkjian in his *History of Armenia*, New York, 1958, pp. 371 ff., and this has been supplemented by a brief résumé of the story obtained from Armenian books (which was kindly supplied to me by my friend Prof. Assadur Guzelian¹ of the Armenian College in Calcutta), not translated into English before. The story runs as follows.

Sanatruk was ruling his country as the lawful king of Armenia. He was accidentally shot and killed in the course of a hunt. Then with the help of the Romans (it must be Parthians or Persians, because the Romans come to the scene some centuries later), Ervant became king of Armenia. He killed all the sons of Sanatruk excepting Artashes, who was saved and hidden by his nurse-maid. The nurse-maid informed Smbat (Sembat) Bagratuni, a prince whose family only had the privilege of crowning the kings of Armenia. Sembat took Artashes under his care and brought him up among the shepherds in the mountains for some time, and then took him to Parthia. When Artashes grew up, he came to Armenia with Sembat, with a Parthian army, and they together started a revolt against Ervant. In the fight which ensued, Argavan, the dragon (or king of the dragons, i.e. of some inimical people), sided with Artashes. Ervant was defeated and made to flee, and then Artashes became king of Armenia. It was Sembat who crowned Artashes formally, following the old custom. Artashes founded the city of Artashat (in Greek Artaxata). The Greek historian Strabo has mentioned that Artashes built this town upon a design given by the Carthaginian General Hannibal, who after his defeat by the Romans in Africa had taken refuge in Armenia. (The Romans had not yet established their power in the East, in the countries of Western Asia including Armenia.)

While Artashes was ruling over Armenia, consolidating his power, the Alan people who lived to the north of Armenia attacked him with a large army. The Armenians took their position on the bank of the mountain stream Kur, facing the Alans who were on the other side.

In the course of the fight which ensued, the Armenians captured the son of the king of the Alans. This disconcerted the Alans, and a treaty was negotiated between the Alans and the Armenians—the Alans wanted to make peace. For this purpose Sathenik, the daughter of the Alan king, came to the river bank and spoke across the river to Artashes, who was with his troops on the other side. Her appeal to the Armenian king across the river has been given in the old epic ballads, and a fragment of this has been reproduced by Moses of Khoren as follows:

kez asem, ayer kaj Artasēs,
or hal'thetshēr kaj azgīn Alanatsh:

¹ I have also to acknowledge with thanks that it was through Mr. Guzelian's friendly help that I was enabled to put to use for this article the two volumes of Simon Simonian's *Hayots' Patmuthiun* (I do not read Armenian)—those two valuable books giving the legends, hero-tales and early history of Armenia. The illustrations by Armenian artists had a special value for me, and through them, with Mr. Guzelian's interpretation, it was easy for me to follow the legends, especially those of Artashes, and the epic of David of Sasun. Mr. Guzelian also very kindly read the proof of this paper with me, and made some corrections and improvements which I gratefully acknowledge.

ek havanyatsh banitsh ačhagel'oy dsters Alanatsh,
 tal zpatanid.
 zi vasn mloy kinou očh ē orēn diutshazantsh,
 zaylotsh diutshazantsh zarmitsh bar'nal zkendanouthiun,
 kam tsar'ayetshoutshanelov i sterkatsh
 kargi pahel, ev thšnamouthiun,
 yavitenakan i mēj erkotshountsh
 azgatsh khaĵatsh hastatel.

'To you I say, courageous Artashes,
 Who defeated the brave nation of Alans:
 Come and accept the words of the lovely-eyed daughter of the Alans,
 And return the boy captive,
 Because it is no rule amongst heroes
 To take the life of another nation's heroes,
 Or making them serve,
 And keeping them in the rank of slaves,
 And establishing eternal
 Animosity amongst two brave nations.'

Artashes listened to this speech from the princess, and he was overcome by her beauty and fell in love with her, and then asked for her hand in marriage, so that the war might be ended amicably. The king of the Alans, on hearing this proposal, thought that the Armenian king would not be able to pay sufficient dowry for his daughter; and these lines occur in the old ballads, as being uttered by the Alan king:

ev usti tatshē kaĵen Artasēs
 hazars i hazaratsh
 ev biurs i biuroutsh
 ǝnd kaĵazgvoy kuys ōriordin Alanatsh ?

'Wherefrom will brave Artashes be able to give
 Thousand-fold
 And ten-thousand-fold
 For the brave Alans' maiden ?'

Artashes was impatient of this delay, and, like a hero of olden times, he carried off the princess by force, by throwing a lasso round her and dragging her to his camp. This episode is also quoted from the old epic ballads by Moses of Khoren—the old chronicler was endowed with sufficient imagination not to miss the romantic charm of the episode, and we are thankful to him for his having preserved for us this oft-quoted passage, of great heroic-romantic beauty, in Old Armenian :

hetsav ari arkhayn Artasēs
 i seavn gel'etshik,
 ev haneal zoskēol'
 šikaphok parann;
 ev antsheal orpēs zartsovi
 srathev ǝnd getn;
 ev dzgeal zoskēol' šikaphok parann
 ǝnkētsh i mējkh ōriordin Alanatsh;
 ev šat tshavetshoytsh zmējkh
 phaphouk ōriordin,

**arag hasoutshanelov
i benakn iur.**

‘ Brave king Artashes
Rode his beautiful black steed,
And he took out the golden-ringed
Yellow leather-rope;
And like a swift eagle,
He crossed the river;
And he passed the golden-ringed rope
Round the waist of the daughter of the Alans;
And he severely hurt
The soft waist of the maiden,
And he brought her quickly
To his camp.’

After this the marriage of the young king of Armenia with the princess of the Alans took place, and this marriage was celebrated with great rejoicings and gifts. In the old ballads also this is how the marriage is described:

**tel’ oski tel’ayr i phesayouthemann Artasishi,
tel’ayr margarit i harsnouthemann Sathinkann.**

‘ It rained showers of gold when Artashes became a bridegroom;
It rained pearls when Sathenik became a bride.’

The king took his bride home, and out of this marriage sons were born to Artashes, and his first son was named Artavazd. This Artavazd was, in later times, confused with the Asha-vazdah (or Arta-vazdah) of the *Avesta*. It is said that he was stolen by the dragons.

The married life of Sathenik and Artashes evidently was not happy, and Sathenik proved to be a faithless wife, like Helen of Troy in the Greek legend, Hbrug-mo the wife of Gesar in the Tibetan saga, and Gwenhwyfar (Guenevere) in the mediaeval West European legend of King Arthur. She manifested a love for Argavan, who was evidently an Iranian, a Medean person of rank, whom Artashes brought to his court and treated with great kindness and honour. One day Argavan invited Artashes to a feast. The sons of Artashes came to know that Argavan wanted to poison their father. Hearing a report of this, Artashes returned to his capital Artashat, and he sent one of his sons, Majak, against Argavan. Majak destroyed Argavan’s palace and returned, but Artavazd, not being satisfied with this, attacked the city of Argavan and destroyed it and killed Argavan. It is said also by Moses of Khoren that the old ballads narrated that Sathenik also carried on her intrigues with some of the foreigners. The Armenian hero-tales here appear to be confused, because they bring in the progeny of the dragons to the scene as being among the lovers of Sathenik. The ballads also describe the rivalries among the sons of Artashes and among their wives, which led to further disunion in the royal family of Armenia. Queen Sathenik wanted to obtain from under the pillow of Argavan certain magical herbs which would ensure for her the love of Argavan. These ballads have unfortunately not been preserved, but some vague references to their contents are found, and only a few lines.

The story of Artashes continued right down to many centuries later. As late as the eleventh century some fragments of this Artashes epic have been quoted by the writer Grigor Magistros. Artashes died in a foreign

country through illness. Some versions say that he was poisoned. The following lines are quoted by Grigor, from the Artashes epic as current in his day, as the last words of Artashes; where the dying king evidently recalls with sorrow the joyful days of the festival of *Navasard* (or the New Year, corresponding to the Iranian *Nau-rōz*)—the life he was leaving for ever:

**ō tayr indz ztsoukh tsexani,
ev zar'avotn navasardi,
zvazeln ezantsh,
ev zvageln el'jervatsh ?
mekh phol' harouakh
ev thmbki harkaneakh.**

' Who would give me smoke of the chimney,
And the morning of *Navasard* (= New Year's Day),
And the running of the deer,
And the rushing of the stags ?
We used to blow the horn,
And beat the drum.'

When Artashes' funeral took place, and his body was lying in state, the old Armenian custom, which was also current among the early Slavs of the East, was followed. Some of the devoted followers of the king according to this custom would commit suicide to accompany their master to the underworld. A good many followers of Artashes are said to have performed this ritual suicide. This made his son Artavazd, who was to succeed him, very angry, and he cried out to his dead father:

**minčh dou genatshir ev zerkirs amenayn ənd khez tarar :
es averakatshs orpēs thağavorem ?**

' You went and took away the entire population of the country with you:
Am I now to rule over the ruins ?'

This annoyed Artashes, even in his death, and from his bed or coffin Artashes cried out and cursed his son in these lines:

**ethē dou yors hetstshes hazatn i ver i Masis,
zkhez kaltshin khajkh
tartshin yazatn i ver i Masis,
and kaytshes, ev zluys mi testshes.**

' If you ever ride and go hunting to Azat Masis,
Let the braves capture you
And take you into the depths of Masis,
To remain there, and never see the light again.'

The father's curse took effect. After Artavazd became king, he went for a hunt to Mount Masis. There some of the giants caught him and bound his feet and hands with iron chains and placed him in a cave. The Artavazd story in this matter appears to have been linked up with the ancient Iranian legend, that of the Dragon Azhi-dahāka being bound in a cave by the hero Thraētaona. Artavazd somehow became the symbol of an evil ruler; and, unless he was kept in chains and put under restraint, he would come out and do harm to humanity. So he has been kept in chains for ever in that mountain cave, to save mankind from some great evil. According to the Armenian people, he is still there, and he has his two

dogs which continually lick his iron chains so that they might free their master. There is a folk-lore tradition current among the people of Armenia that Artavazd must for ever be kept in chains in his mountain prison, and every evening, before closing their work for the day, the Armenian blacksmiths strike the anvil with their hammers, doing this as a symbolical action to strengthen the chains of Artavazd.

Artavazd's character has been described in different ways. In the legends, as preserved by Moses of Khoren, the demoniac aspect of Artavazd has been emphasized, and it was apprehended that he would destroy the world when he would come out. But another Armenian writer of the fifth century, Eznik Kol'batsi, gives a more favourable account of Artavazd and describes him as a good character who will save Armenia when he is delivered out of the cave. According to Eznik, who took his story evidently from a different version of the legend, Artavazd was imprisoned by the demons or devils.

The above in brief is the story of Artashes and his son Artavazd. Here, as we can see, genuine Armenian history (as in the fight between the Armenians and the Alans, and the romantic story of King Artashes wooing and wedding Princess Sathenik) has been mixed up with the primitive myth of the enchainment of an evil dragon, and his being kept in perpetual captivity to save humanity—a myth which came to the Armenians through Iranian sources, though probably ultimately from the earlier peoples of the Caucasian area.

E. OTHER EPIC TALES: THE STORY OF KING ARSHAK

The story of the earlier Armenian heroes like Haik and Ara as well as Artashes, as given above, are more or less confined to history books, although their literary and romantic quality is fully understood and appreciated by educated Armenians. There are other romantic stories, mostly about various heroes and fighters for Armenia's freedom, which have similarly been narrated by chroniclers, and they also contain heroic elements. There is the fine story of King Trdat (Terdat, Tiridatēs III) and his conversion to Christianity by Surb Grigor Lusavorich (Saint Gregory the Illuminator); and this event (A.D. 301) led to the general conversion of Armenians and the emergence of the Armenians as the first Christian nation. This is a romantic-religious legend narrated in a beautiful style in the chronicle of *King Trdat and Surb Grigor*, narrating events in Armenia from A.D. 226 to 330, and is attributed to the monk Agathangelos. This work was translated into Greek and Georgian (Grusinian) as well as Arabic, as the life of a great Christian saint. The highly dramatic life of Arshak II (350–367), who was king of Armenia at a time when Armenia was the bone of contention between the Roman and the Sassanian emperors, belongs to what may be called the later heroic period of Armenian history. This has been treated in beautiful Old Armenian prose by the historian Phavstos Bizand of the fifth century. The life of this king was an unhappy one. He could not get support from the Romans, who were Christians. He fought the Persians with the help of his great general, Vasak Mamikonian, and he surrendered to Shāh-puhr, the Sassanian king, who at first received him well and then confined him to the fortress of Anush ('Oblivion') Bert together with his faithful general Drastamat. The brave General Vasak Mamikonian was flayed alive. Arshak first married, in 357 A.D., Olympia, a Roman (Greek) princess. She was subsequently put to death by poison under suspicious circumstances. Other episodes in the story are the part taken by Nerses, the Catholicos, in the affairs of state; the treason of his

nephews, Gnel and Tirid, who were captured and executed by Arshak's soldiers; Pharantsem, the beautiful widow of Gnel, her appeal to Nerses, and her subsequent marriage with Arshak; Pharantsem's heroic resistance to the Persians with her son Pap, and her brutal murder after defeat by the Persians; the enthronement of Pap as King of Armenia in 368 by Roman help, and his subsequent murder by Roman treason in 374: all this forms the subject-matter for a heroic saga of great tragic quality, as narrated by Phavstos Bizand.

Then there is the history of the Armenian heroes who resisted the aggression of the Zoroastrian Persians in the fifth century, Vartan Mamikonian and his followers, which has been narrated in the prose chronicle of Elishe (Yeghishe) Vardapet (c. A.D. 470) and Lazar of Pharp (slightly later than Elishe), in glowing language.

F. THE EPIC OF DAVID OF SASUN (SASUNTSI DAVITH)

But the epic story which is still living as a national possession among the Armenians is the story of *Davith Sasuntsi* or David of Sasun. Herein we have a series of epic ballads which have been collected as late as the fourth quarter of the nineteenth century and the first half of this century. These ballads were sung by the people all over Armenia, and only from 1874 scholars have tried to collect whatever could be obtained from people in the villages who still sing these epic and romantic songs.

The hero of this national epic of the Armenians is David of Sasun, the theme is the age-old theme of Armenia—her struggle against foreign oppressors. In the story there are certain supernatural elements, and some of the characters are conceived on something of a Gargantuan scale. The story is a mixture of the human and the super-human. It is a composite story, and certain elements of it go back to the pre-Christian period of Armenian history. One or two episodes even suggest a survival of primeval myths of ancient Armenia, whether Indo-European or Semitic, Babylonian or Caucasian. The ballads had their own line of development, and they did not have the benefit of having some *diaskeuastēs*—some compiler or editor of genius—who like a 'Homer' or a 'Vyāsa', a Thomas Malory or an Elias Loennrot, could give to these floating mass of ballads a consistency and a unity, and create out of them an epic poem or tale which could be compared with the Sanskrit *Mahābhārata* or the Greek *Iliad*, the consistent Arthurian Epic which the English *Morte d'Arthur* is, the Finnish *Kalevala*, or even to the Middle High German *Nibelungen Lied*. Nevertheless, these ballads show a single story involving four generations of heroes; and although as many as 60 variants of this story or parts of it have been found, there is a basic unity.

The main story of David of Sasun centres round the struggle of the Armenians against the Arabs from Egypt and Baghdad or Mesopotamia. In the seventh, eighth, ninth and tenth centuries, the Muslim Arabs were troubling all the Caucasus areas. David of Sasun typifies a series of unknown heroes who gave fight to the hated aggressor. In addition to patriotic motives and motives of self-preservation, there was also the religious sentiment. The Armenians as a nation, which prided in its Christian religion, did not want to be converted to Islam, which was the prospect for them under Arab rule. In the person of David of Sasun we have in a way the Armenian people itself in one of the main critical periods of its history. David of Sasun is looked upon as the apotheosis of Armenia's spirit of resistance from very early times.

With the Armenians, David of Sasun has been a national hero, whom they have rediscovered during the last 80 years. He has been described as 'the soul of Armenia', with his patriotic and humanistic outlook and with his noble thoughts and noble aspirations, and dreams for bringing in the millennium not only for Armenia but for the whole world.

In 1874 Bishop Garekin Servandztiantsh collected from Sasun district itself—the centre of David's exploits and his home—a number of ballads relating to David. Then in 1886, the Academician Manuk Abeghian (or Abel'ian), who is considered to be the greatest authority on Armenian folklore and epics, made another collection. Another important work on the David of Sasun epic was that of the poet Hovhannes (or John) Thumanian (1869–1924), and his poetical work on David of Sasun is based on collections of old songs and ballads from the villages as well as on whatever he could obtain from the older literature.

By 1914, some 20 variants of the epic came to light, both of episodes and of the main story. The important names in this work of collection and popularization are, in addition to those of Bishop Servandztiantsh and of other scholars mentioned above, those of Garegin Vardapet Hovsebian, Kh. Vardapet Datian, S. Haikuni, P. Khalatianth, T. Lalayan, S. Ganayan and Dikran Tchitouny (see Dikran Tchitouny, 'Armenian Popular Epics', in *Massis: An Organ of Armenian Interests*, London, Vol. I, No. 8, June, 1929, p. 174). Recently a very complete work in Armenian on David of Sasun by Grigor Grigorian (*Erevan*, 1960, 783 pages) has come out, discussing the whole subject from all aspects.

In 1939, when the 1,000th anniversary of David of Sasun was celebrated with great enthusiasm all over Armenia, the main collection of the Sasun ballads, giving in their totality a complete David of Sasun Epic, was brought out by a number of top-ranking Armenian scholars—like Prof. G. Abov, Prof. M. Abeghian, Prof. Ohanjanian and Prof. A. Ghanalanian. A Russian translation of this newly collected Armenian Epic of David of Sasun has been recently brought out (in 1958) from Moscow in a sumptuous edition, with a number of illustrations by four Soviet (Russian) artists. In December, 1959, a beautiful and spirited equestrian statue in bronze of the national hero, by the distinguished Armenian sculptor, Suren Khochar, was erected at Erevan, the capital of Soviet Armenia.

The Epic of *Sasuntsi Davith*, as it stands, consists of Four Sections or Branches, dealing, as has been said before, with four generations of heroes. These four parts are as follows:

- (I) The history of the two brothers, Sanasar and Pal'tasar (Baghdasar), who were respectively the grandfather and grand-uncle of David.
- (II) The story of Mher (Meher in modern pronunciation), the son of Sanasar. Mher was known as *Arutsh Mher* or 'Meher the Lion'.
- (III) The story of David of Sasun himself.
- (IV) The story of David's son, who was also known as Mehr, but he was described as *Phokr Mher* or 'the Young Meher' to distinguish him from his grandfather, Meher the Lion.

A *resumé* of these Four Sections is given below.

(I) The story commences with the miraculous birth of the two brothers, Sanasar and Pal'tasar (Baghdasar).

Gagik, who was king of Armenia, ruling under the suzerainty of the Arab Khalif of Baghdad, had a beautiful daughter who was known as Tsovinar, and she was also known as Lusik. These names have a mythical import—*Tsovinar* is the old Armenian 'Goddess of the Sea', and *Lusik*

signifies 'Light, or Little Light'. The tax-collector of the Khalif saw the daughter of King Gagik, and he was very much impressed by her beauty, and informed his master at Baghdad about Lusik. The Khalif demanded the hand of the Armenian princess in marriage, but he was refused. At this he invaded Armenia with a big army, and the princess agreed to go to the harem of the Khalif to save her people.

Before she went to Baghdad after being accepted as the Khalif's wife, she had conceived in a miraculous manner while still a virgin. One day she went to walk on the beach by the sea, and there she saw a white marble stone which was close to the sea. By the power of God, the stone split up, and out of it came a rushing fountain or stream. She got into it for a bath, and then she drank from the waters a full handful at first, and again half a handful, and then she went back home. From this she conceived. In that condition she was taken to Baghdad as a bride of the Khalif. But when her condition was known, the Khalif wanted to kill her, but ultimately she was allowed to be delivered of her child, and she gave birth to two sons. The sons grew up, and somehow their killing was deferred for ten years. Finally the Khalif sent his executioners to kill the mother, but the two brothers killed them with all their attendants. The Khalif then desisted from troubling them any further.

The story of the miraculous conception of the princess certainly goes back to some old pre-Christian Armenian myth. The princess is named the 'Goddess of the Sea', and she drank the magical water of the fountain from the white marble stone by the mountains, and close to the sea. Later on, her elder son, Sanasar, was able to dive down into the sea, and from there he brought some miraculous articles. The princess therefore represents some old sea or water divinity. Her other name Lusik or 'Light' also suggests some solar antecedents.

The Khalif of Baghdad, the husband of the princess, fought for seven years against Armenia, but he was defeated and he came back to Baghdad in a rout.

As in Western Europe, the Armenians also in those days did not care to understand the Islamic religion of the Arabs, and had mixed up the Arabs with the pre-Christian Babylonians who also belonged to Mesopotamia or Iraq where Baghdad is situated. The Baghdad king was looked upon as an idol worshipper, and it is said in the ballads that he vowed to his big idol or big God that if he could obtain victory over the Armenians, he would sacrifice the two brothers before his God. Queen Tsovinar heard about that, and she sent her sons far away from Baghdad. While travelling through some mountains, the brothers came to a fountain or hill-stream, and both the brothers drank deeply from the fountain, and they obtained superhuman strength from that. It was a sort of fountain of immortality.

The two brothers built a very strong fort in Armenia. There was a local prince of Armenia named Melkon, who supported the two brothers. When they had built this fort, the old man, King Melkon, was very much pleased. Looking at the tall proportions of the fort at Sasun, which was built by the brothers, he said in Armenian—*Sa Sun*, or 'this is a Pillar'. From that, the fort or castle took its name of *Sasun*. Another interpretation of the name is that it means 'Wrath', and the castle was evidently to be a symbol of the righteous indignation of the Armenian people against foreign domination and oppression. This fortress became a rallying point for Armenians who were troubled by the Arabs, and who wanted to free themselves. After establishing themselves there, Sanasar, the elder brother, as one of his great adventures dived into the sea and brought out from

there a miraculous Horse which was known as the *Kurkit Jalali*, and the Lightning Sword, known as the *Tur Kaitzaki*, and he came out of the sea sitting astride on this horse and brandishing his sword.

After these, the two brothers went to Baghdad and presented themselves before the Arab king. The king wanted to force them to worship his idol. The brothers feigned ignorance of the ritual of worship and asked the Arab king of Baghdad to show them how to do it. As the king knelt before the image of his God to do worship, the two brothers attacked him from behind and killed him, and then they escaped with their mother, Queen Lusik or Tsovinar, to Sasun. One version of the story says that Pal'tasar, after the killing of the king of Baghdad, stayed on there and began to rule over Baghdad. Later on Pal'tasar was attacked and killed by an Arab king whose name is given as Mesra-Melik or 'the king of Egypt'.

There are also other episodes connected with the two brothers. The fame of the two brothers spread. The daughter of the king of the 'City of Bronze', whose name was *Del'dzun-tsam* ('Blond-hair'), fell in love with Sanasar by hearing about him, and sent a letter to him. Sanasar went to the City of Bronze, and he had to fight sixty champions who were sent by the king of the city to kill Sanasar. Pal'tasar came to the help of his brother. They went to a town known as the Green City, where there was a dragon who was not allowing people to drink from a river on which the city stood. This dragon typified the tyrannical foreigners in Armenia. The two brothers killed the dragon and freed the city. Then they conquered the king of the City of Bronze, and Sanasar married Princess *Del'dzun-tsam*, and the younger brother Pal'tasar married her sister. According to another version, Sanasar was married to the daughter of King Melkon, who had given his support to the brothers when they built their castle of Sasun. Meher the Lion, the son of Sanasar, was born from this lady. Sanasar had three sons, Virgo, Dzenov Ohan, and Meher the Lion. Dzenov Ohan had a powerful voice, and he was known as 'the Shouter' (*Zenov*).

(II) *Mher (Meher) the Lion*.—Meher, the son of Sanasar, came to be known as *Meher the Lion* because while quite a young man he killed a lion with his bare hands. Like Persian heroes of ancient times or mediaeval knights of Western Europe, Sanasar moved about fighting with evil giants and killing them, and he saved the daughter of King Theodoros, who was named *Armal'an* (*Armaghan*, 'Present, Dowry'), and married her. In the meanwhile the Arab king of Egypt, Mesra-Melik, hearing of Sanasar's death attacked Armenia. Before he could come to Armenia, Meher the Lion went to the border to fight him, and won the battle. Mesra-Melik made peace, and became Meher's ally. They made a pact that of the two friends when one died first the survivor would look after his wife and children. Mesra-Melik died first. The wife of Mesra-Melik, *Ismil Khatun*, then called Meher from Armenia to Egypt. She made him drunk with seven-year old wine, and Meher forgot everything about his own country and lived with her. They had a son, who was also known as Meher. (This episode is peculiar to one version of the story only.) On one occasion, Meher the Lion heard *Ismil Khatun* speaking to her son by him that when this young boy would grow up, he should attack Armenia and destroy the fort of Sasun. At this Meher came to his senses, and he returned to Armenia. During Meher's absence in Egypt in the company of *Ismil Khatun*, his wife *Armal'an* was in Armenia, and she was very much annoyed at the lapse of her husband. When her husband came back, she imposed the condition that if she was to live with him, they were to have one son only. It happened that as soon as the son of Meher and *Armal'an*

was born, both died the same day. This was looked upon as Meher's expiation for his infidelity.

(III) *Sasuntsi Davith or David of Sasun*.—One version of the David Epic or Saga says that David in his boyhood was sent to Mesr or Egypt, the kingdom which was now in possession of his step-brother Meher II, and his step-mother, Ismil Khatun, who was formerly the wife of Mesra-Melik. David there refused to drink what was offered to him by Ismil Khatun—he only drank the milk and honey which he had taken with him from Sasun. This saved David from coming under the power of Ismil Khatun's magic. He returned to Sasun. The Arab rulers of Egypt had their eyes on Sasun. David in his boyhood was not told about his exalted origin. He had to pass his early days as a shepherd, and he went to live in the mountains. There he brought wild animals under his power and collected them—bears and lions, wolves and leopards and wild cattle—and brought them to the village, and this made the villagers afraid and fight shy of him. His uncle Dzenov Ohan then appointed him to look after cattle. David left this work, and became a mighty hunter. On one occasion he killed 40 thieves and cattle-lifters and obtained their gold and wealth, which he gave to the people of Sasun.

David in his childhood and youth evidently was a very wild and untamed sort of person, and he used to play practical jokes and pranks upon the people, and make free with their property. On one occasion he picked up some vegetables from the garden of an old widow, and this lady, who knew David's antecedents, came to him and reproached him for it, and told him that he ought to redeem his father's heritage, which was in the possession of the Arab Melik. This brought David to his senses, and he came to know about his parentage, and that made him determined to drive the foreigners from his country. While yet a boy, and his father's kingdom was under Mesra-Melik, the people of Armenia were, as a sign of humiliation, made to pass under a sword held by an Arab soldier. David refused to pass under the sword, and then he attacked and killed the soldiers and made good his escape. On another occasion, again, when David was in front of the officers of Mesra-Melik, who were making an inventory of gold vessels and coins collected from the people of Armenia and were measuring the bullion in a measuring vessel, David came and picked up the vessel and threw it away with such force that people believe that it is still flying in the air. He went on another occasion to a forest which was his father's preserve for hunting animals, and there he set free all the animals. A mountain region by the sea, in Armenia, called Tsovasar, used to be ruled by the king of Mesr. David went there and killed all the soldiers of the king of Mesr, excepting their leader Kholbashi, who fled to his master and warned him about David's growing power. The king of Mesr sent another General, Gol'bati (Goghbat), against David, and he came with his troops, but he was killed. Then finally the Arab Melik himself came to fight with David.

In the meanwhile David had secured his father's horse Kurkik Jalali and his lightning sword. He with his followers attacked the army of Mesra-Melik and killed a great many of the enemy. When he was working a great havoc with the Arabs, an old man from Mesra-Melik's army came to David and admonished him not to kill so many people. The Arab army was also in a difficulty because their master, Mesra-Melik, was in one of his prolonged slumbers—it was said that he, when he fell into a deep sleep, must sleep for 40 days without being disturbed, before he would wake up. (This characteristic of Mesra-Melik reminds one of the *Rāmāyana* character Kumbha-karna, the brother of Ravana, the demon-king and enemy of Rama,

the hero of the epic, and although a great warrior, Kumbha-karna could not be awakened from his long spell of sleep, and when he was finally awakened, he fought, but he was killed.) However, Mesra-Melik was got ready to fight David. After the two leaders came face to face, it was settled that the issue of the battle would be decided by a duel between David and Mesra-Melik. Each of them was to throw a sword three times against his rival. After Mesra-Melik threw his sword thrice against David and failed to hit David on each occasion, it was David's turn. To save her son, Mesra-Melik's mother came to David and prayed that the first sword was to be cast upon her and not upon her son. David refrained and his first throw was without any use. Then Mesra-Melik's sister came and persuaded David not to throw his sword a second time against Mesra-Melik. There remained only the third chance for David to settle matters with Mesra-Melik with his sword. In the meanwhile, Mesra-Melik flew with his horse into a chasm of the hills, and then he prepared himself by having his armour on his body with forty grinding stones and on the top of that he had leather bandages from forty oxen. In spite of this Gargantuan armour it did not avail him, and David the hero killed him with one blow of his sword, which cut through all this protection. The sword was so sharp that when Mesra-Melik was cut through he did not feel it. But nevertheless he died.

This was the greatest heroic achievement of David, and after that, as a triumphant victor, he came back to his own home as a conqueror, and the people sang his praises in this manner :

Sasuntsi Davithin phar'kh hal'takan,
phar'kh hal'takan Sasuntsi Davithin :

i.e. 'Glory to the triumphant David of Sasun.'

According to one late version of the legend, the Pope of Rome sent an army from Italy against Mesra-Melik. But this army was repulsed by David. This version just presents a memory in the Armenian national mind of the struggles which the Armenians had to wage against the Crusaders, who of course were inspired by the leader of Western Christendom, the Pope of Rome.

The princess of a neighbouring State sent her minstrels to David to sing his praise, and also to sing about her beauty before him. David fell in love with this princess, whose name was Khandut. David had already promised to marry the daughter of the Byzantine king, Chemeskhik. But he repudiated his proposed marriage with the Byzantine princess and married Khandut instead. There is a romantic episode in one of the versions that David went to the city of Khandut's father, and while resting in a beautiful garden belonging to the king he fell asleep, and the young princess Khandut with her handmaidens saw the handsome sleeping hero, and this made her fall in love with him more than ever. David and Khandut had a happy married life, and David had a son by her, who came to be known as *Phokr Mher* or 'Meher the Young'.

After this David went on a seven-year campaign to Giurjistan or Georgia. The young prince Meher went to search for his father, and on the way they met, and like Rustam and Sohrāb in the Persian epic, the *Shāh-nāmah*, David the father and Meher the son fought with each other. It was a terrible fight, but finally they recognized each other and stopped. But David was angry because of this fight, and he cursed his son for fighting his father that he would never die and would never have a son.

It is said in the David songs that the Byzantine king Chemeskhik,

whose daughter David had refused to marry, managed to poison and kill David. In this way the great hero of the Armenians passed away.

David's son Meher, however, took revenge for his father's death and killed Chemeskik.

(IV) *Meher the Young.*—Meher left the country after the death of his father and of his mother, and he wandered all over the world. As a great champion of the oppressed, everywhere he fought with evil characters. He married the daughter of the king Pajik, a princess named Gohar (a Persian name meaning 'Jewel'). Then he heard that the grandsons of Gol'bat (the General of Mesra-Melik who was killed by his father David) were ruling in Baghdad and were giving trouble to the people of Sasun in Armenia. Meher at this went to Baghdad and killed the grandsons of the Arab General. He then returned to his wife, evidently in her father's home, and there he found that his wife was dead. He brought her body to Armenia. Widowed in this way, he wanted to wander again, but he felt growing old and fat and heavy.

He then went to his parent's grave and prayed to them. His father, David of Sasun, gave a response from his grave in these terms: 'Go to Van, and there you will find your destiny.'

Meher then went to the mountains near Lake Van, and there he entered a cave which closed round him. Thus his father's curse was fulfilled, and he was imprisoned within that cave; and he did not die. He is waiting there, and he will come out when wheat grows to be as big as a berry or a walnut, and there will be peace and prosperity and plenty and happiness for the Armenian people (this is like a reflex of the story of Artavazd, who has been similarly kept imprisoned within a cave).

This in brief is the story of the Armenian folk-epic of David of Sasun. Here we have the Armenian ideal of a hero and a ruler. The hero was always helping the poor and the oppressed, and above all opposed the subjugation of his country and fought to free his motherland from foreign oppressors. The hero-king was for abolition of taxation—unlike the Arabs who had been taxing very heavily the Armenians and other people under them. David thus represents in himself the spirit of Armenia through some of the centuries, and in some of its greatest national crises. As such, we can understand his great popularity, and the Armenian people, now freed from the yoke of their Turkish rulers, have rediscovered him and have established him on his high pedestal as the National Hero of Armenia.

I had the privilege of discussing the subject-matter and the arrangement of the above paper with Academician Joseph Abgari Orbeli, himself an Armenian, Chairman of the Caucasian Section, after the formal termination of the 25th International Congress of Orientalists in Moscow on 16th August, 1960, and Dr. Orbeli expressed his great interest in my paper, which he promised to read, and to favour me with his comments. But unfortunately this veteran scholar of Armenian and Caucasian studies passed away shortly afterwards, and I can only record here my grateful thanks to his memory for the cordial *imprimatur* he had given to my rather amateurish study.—S. K. C.

STUDIES IN THE GUPTA ADMINISTRATION

By SACHINDRA KUMAR MAITY

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Indologists have always expressed a very high opinion about the achievements of the Gupta Age, which reached a high watermark of culture and civilization. It received its strength and vitality from the continuous rule of more than two centuries successively under Chandragupta I, Samudragupta, Chandragupta II, Kumāragupta I, Skandagupta and others. They profitably helped the progress of administration, at least in the major part of India.

CENTRAL ADMINISTRATION

Most of the ancient authorities¹ in matters relating to administration, such as Kautilya, Manu, Nārada, Brihaspati, Kāmandaka and Śukra, declare that a State or *Rājya* is constituted of seven elements, viz. *Svāmin* (ruler or sovereign), *Amātya* (minister), *Janapada* or *Rāshṭra* (the territory of the State and its people), *Durga* (fortified city or capital), *Kośa* (accumulated wealth in the ruler's treasury), *Danḍa* (army) and *Mitra* (friends or allies). These seven parts are generally considered as the constituents (*aṅgas*) of the body of the State.

The Gupta emperors discarded the modest title of *Rājan* used by the indigenous dynasties of earlier times. They adopted high-sounding titles or epithets like *Parama-bhāgavata*, *parama-bhaṭṭāraka*, *Paramadaivata*, *Achintya-Purusha*, etc. as is evident from most of the Gupta inscriptions and coins.² This indicates a great change in the conception of kingship in this period, which, to some extent at least, must have been due to the influence of the Indo-Greeks, Kushānas, Śakas, etc.

The Maurya king was a mortal, though a favoured mortal (*Devānam-piya*).³ But under the Guptas, kingship assumed a semi-divine character. In the Allahabad pillar inscription Samudragupta is referred to as a god dwelling on earth, and a mortal only in celebrating the rites of the observances of mankind.⁴ He is also described as 'equal to the gods Dhanada (Kubera), Varuṇa, Indra and Antaka (Yama)', who had 'no antagonist of equal power in the world', and who was 'the battle-axe of the god Kritānta (Yama)'.⁵ With the same object of claiming superhuman excellence, the coin legends of the Gupta emperors refer to them as having 'acquired heaven by good deeds'.⁶

¹ Kāman., 1.16; Suk-I, pp. 122-124; Kane (H.D.S. 111, p. 17).

² Smith, Allan and Altekar (Gupta coins); Fleet (c. 1.1); *Ep. Ind.*, XVII, p. 347; XXI, p. 8.

³ Hultzsch (c. 1.1).

⁴ Fleet, p. 6.

⁵ *Ibid.*, pp. 6, 53; Battle-axe coins of Samudragupta.

⁶ *Ibid.*, f.n. p. 2.

In the Gupta empire the king was the supreme head of the State and administration. Inscriptions show that the ideal of kingship in the Gupta

Royal qualities.

Age was very much the same as found in the Smṛiti literature and in the works of Kālidāsa. The Bhitari pillar inscription referring to the qualities of Skandagupta states: 'He subdued the earth and became merciful to the conquered people, but he became neither proud nor arrogant though his glory was increasing day by day.'⁷ Moreover, 'Samudragupta was kind to the miserable, the poor, the helpless and the afflicted'.⁸ 'He had a sharp and polished intellect and musical accomplishment and had the title of the king of poets by various poetical compositions.'⁹ The emperor also 'wants welfare and happiness of all existing beings'.¹⁰ Sometimes, the 'Gupta king is called an exterminator of all kings'.¹¹ In one inscription Kumāragupta I is said to have 'followed the true path of religion'.¹² Thus, Kāmandaka has rightly remarked: 'The king is the cause of the prosperity and progress of this world, and is held in high estimation even by the aged men. He also affords delight to the eyes of men.'¹³

The Gupta kings were highly influenced by the stories and legends embodied in the Epics and the Purāṇas. They were very often compared to

The Epic ideal of the king.

the famous characters of the two Epics. In respect of strength and valour Samudragupta, Chandragupta II, Kumāragupta I and others are often compared to Indra, Yama (Kṛitānta) and Kārtikeya¹⁴ as already mentioned. Moreover, the high ideals of the two great Epics often guided the attitude of the king towards his subjects. In kindness Samudragupta and Kumāragupta I were equal to Dhanada and Varuṇa.¹⁵ They were the givers of millions of lawfully acquired cows and gold. In their adherence to truth and moral attainments their aim was to be as famous as Yudhisthira.¹⁶ It is also recorded that 'Skandagupta subdued the earth and became merciful even to the conquered people in distress'.¹⁷

Some of the Gupta kings were experts in diplomacy. Samudragupta, for instance, presumably knowing the limitations of a northern power, thought

Their diplomatic skill.

it prudent to reinstate the conquered kings of the Dakṣiṇāpatha.¹⁸ Kālidāsa has probably in his mind a Gupta king of this type when he states that Dilip was very intelligent in state-craft and diplomacy.¹⁹ The necessity of a sound diplomatic training on the part of a sovereign is emphasized in the Nitisāra of Kāmandaka.

Dr. Beni Prasad remarks that 'it was not long before public opinion and political philosophy held up to admiration the ideal of "the big kingdom", "the kingdom extending up to the sea", "the universal dominion". Constant efforts were made to realize the ideal in some practical form or other in reality or in name'.²⁰ The Gupta inscriptions very often mention this ideal, and the kings of this dynasty sought to achieve the 'universal empire'.²¹ As a result of their great military conquests, the good names of Samudragupta, Chandragupta II, Kumāragupta I and Skandagupta were 'tested by the waters of the four oceans'.²² 'They had no antagonists of equal power in the world'.²³ The kingdom of Skandagupta was 'bounded

⁷ Fleet, p. 53.

⁸ *Ibid.*, p. 6.

⁹ *Ibid.*

¹⁰ *Ibid.*, pp. 43, 49, 53; *Ep. Ind.*, XXI, p. 8 (*ref.* Gupta coins).

¹¹ *Ibid.*

¹² *Ibid.*, p. 43.

¹³ Kāman., 1.9.

¹⁴ Fleet, pp. 6, 43, 49; their gold coins.

¹⁵ *Ibid.*

¹⁶ *Ref.* Gupta Ins.

¹⁷ Fleet, p. 53.

¹⁸ *Ibid.*, p. 6.

¹⁹ *Raghu*, 1.20.

²⁰ Stated in *Ant. India*, p. 4.

²¹ Fleet, pp. 6, 43, 53, 56, etc. (*ref.* Gupta coins also).

²² *Ibid.*

²³ *Ibid.*

by the waters of the four oceans'.²⁴ Similar exaggerated statements occur frequently in the epigraphic records of the Gupta kings.

Besides the proper maintenance of law and order in the State, it was always considered the duty of the Hindu rulers to support the Brāhmaṇas, Sramaṇas and others to hold assemblies of poets and learned men, to make gifts of land to religious and educational institutions and to advance learning in every possible way. Not only did great kings like Samudragupta, Chandragupta II, Kumāragupta I and Skandagupta endow lands and money for Brāhmaṇas, Buddhists and Jainas, but even the lesser kings like Buddhagupta, Bhānugupta, Vainyagupta and others continued this practice.²⁵ Thus, the spirit of toleration and respect for other religions are the keynotes of the Gupta Age.

The Gupta kings were the great patrons of art, science and literature. Samudragupta himself was 'the king of poets'.²⁶ In the field of literature Śudraka, Viśākhadatta and others of lesser repute were outshone by the brilliancy of Kālidāsa, who has been called by Rawlinson 'the Indian Shakespeare'. In the field of mathematics and astronomy, the Gupta Age produced such scientists as Aryabhaṭṭa and Varāhamihira. Under the steady patronage of the Gupta kings the different branches of art reached a remarkable level of excellence. Music also received State help, especially under Samudragupta.²⁷ The kindred arts of architecture, sculpture and painting exhibit remarkable signs of physical beauty, dignity and gracefulness of pose, transparent robes, elaborate haloes and wigs.

The king was always expected to rule the kingdom according to the laws of the sacred texts and Gupta inscriptions, and the contemporary literature very often mentions this fact. Perhaps all the Gupta kings did not possess all the requisite qualities in the same degree. There is no doubt that kings like Chandragupta I, Samudragupta, Chandragupta II, Kumāragupta I, Skandagupta and others had qualities of statesmanship, heroism, self-reliance and intelligence. This is evident from their achievements both in the political and other fields. Especially in ancient India, the fate of a dynasty largely depended on the personality of the king, and the reign of a king not having the necessary qualities often caused disaster. This must account for the misfortunes which overtook the Gupta dynasty during the reigns of the successors of Skandagupta.

Besides being the administrative head of the State, the king was the leader of his army.²⁸ It was he who settled the military policy and in various ways took a leading part in the struggles for supremacy or for the preservation of the empire.²⁹ The supreme control which the king exercised over his army was of great importance in the Gupta State. Samudragupta's brilliant campaigns in Āryavarta and the Dakṣiṇāpatha bear unmistakable testimony to his greatness as a military leader.³⁰ His son and successor, Chandragupta II, also launched many successful campaigns against the Śakas, Bāhikas and others.³¹ Skandagupta, the last great ruler of this dynasty, saved the Gupta empire from the attacks of the Hūṇas and the Pushyamitras.³² No doubt the king was assisted by his minister for war

²⁴ Fleet, p. 53.

²⁵ Ref. Gupta Ins. and Coins (Aśvamedha coins, etc.).

²⁷ Allan, *Lyrical Coins*; and Kālidāsa's *Mālavikāgnimitra*.

²⁸ Gupta Ins. and Raghuvamśa.

²⁹ Fa-hsien, p. 57. (*Record of the Buddhist Countries*. Pub. Chinese Buddhist Association, Peking, 1957).

³⁰ Fleet, p. 6.

³¹ *Ibid.*, pp. 25, 141.

²⁶ Fleet, p. 6.

³² *Ibid.*, pp. 53, 58.

and peace as well as the high military officials in carrying out war operations. But the final decision regarding tactics and strategy must have rested primarily with the king.³³

The most typical of the royal titles, *Mahārājādhirāja*, adopted by the Gupta kings, appear alike in their inscriptions, coins and seals. They

Royal titles. always prefer high-sounding titles as previously mentioned. Titles such as *Sarvarājochchhettā*, *Vyāghraparākrama*, *Parākramāṅka*, *Apratiratha*, etc., were not uncommon. The assumption of these was quite in consonance with the extraordinary power which the king exercised in all spheres of administration. †

The king had absolute authority over all the affairs of the State, but, like other rulers of ancient India, the Gupta king had a council of ministers to assist him. In military and foreign affairs he was certainly assisted by the *Senāpati* and the minister for war and peace.

Only the chief queen in the Gupta Age was designated as *Mahādevī*. The Allahabad pillar inscription refers to *Mahādevī* Kumāradevī, the wife of Chandragupta I and the mother of Samudragupta.

Chief queen. Dhruvādevī, Anantadevī, Chandrādevī and others were also *Mahādevīs*. They had some influence over the administration of the country. Throughout his long reign Chandragupta I issued gold coins jointly in the name of himself and of Kumāradevī.³⁴ Her importance in the State can be noticed from a number of Gupta inscriptions. For long years Prabhāvatī Guptā ruled the Vākāṭaka kingdom as a prince regent. Moreover, the Gupta queens had the power of bestowing lands and money to religious institutions.³⁵ In ceremonies like *Aśhamedha* and others the chief queen along with the king always played a very significant role.³⁶

Next in rank to the emperor stood the crown prince. Succession in the Gupta empire was confined to hereditary descent in the male line and generally the eldest son used to succeed his father.

The crown prince and the royal succession. But the principle of primogeniture was not always followed. Chandragupta I had probably more than one son, but he selected Samudragupta as his successor (*Yuvarāja*).³⁷ Chandragupta I seems to have been helped by his able son in warfare and possibly also in some administrative matters, as was the vogue in ancient Egypt. The training of Samudragupta as a *Yuvarāja* may have been of great use to him in building up a great empire in course of time.

For the proper administration of the country the king was assisted by a group of ministers (*mantrins*). They were largely responsible for the

The ministers and the Mantri Parishad. general welfare of the State. The ancient law-givers generally state that ministership should be hereditary if the son was as capable as his father.³⁸

But according to the *Rajanītiprakāśa* the hereditary principle was to be given up if the son or grandson of a former minister had not the necessary qualifications, but such a descendant was to be appointed only in such State work as was suited to his attainments.³⁹ Thus, the practice of hereditary succession to ministerial posts where the son was an able candidate was probably followed in the Gupta State. Virasena-Śāba was the

³³ Fleet, pp. 6, 25, 53, 58, 141; ref. *Raghuvamśa*.

³⁴ Smith; Allan (*Chandragupta—Kumāradevī coins*); Dr. Maity—*Eco. Life in the Gupta Period*, Appendix III.

³⁵ *Ep. Ind.*, XV, p. 41; *J.A.S.B.* (N.S.), XX, p. 58, etc.

³⁶ *Aśwamedha* coins.

³⁷ Fleet, p. 6.

³⁸ Kane (*H.D.S.*), III, pp. 107-108.

³⁹ *Rājanīti*, p. 176.

Sachiva-Saṁdhivigrahika of Chandragupta II. He held the position acquired by hereditary descent.⁴⁰

As regards their qualifications, the ministers of a monarch 'should be high-born, pure-minded, heroic, learned, loyal and experts in the practical application of the science of polity'. And 'all the actions and omissions of a king should be examined by his ministers, who follow up his schemes until they are successful'.⁴¹

Their accomplishments are also recorded in the Gupta inscriptions. Virasena-Sāba, the minister of Chandragupta II, 'knows the meanings of words and logic and the ways of mankind'. In the important State affairs he had to give the king proper advice. While Chandragupta was engaged in military campaigns, Virasena accompanied the king up to Udayagiri from Pāṭaliputra.⁴² Thus it is assumed that he assisted the king in his Śaka campaigns in the west. There was perhaps no clear-cut division of the civil and military duties of the Gupta ministers, as in the days of Śivāji and his *Aṣṭa-Pradhāna*. They were sometimes simply called ministers (high counsellors), *Saṁdhi-Vigrahika* (minister for war and peace), *Kumāramatyas* (cadet-minister), and *Mantri-Kumāramatyas*.⁴³

It is not, however, very clear from the Gupta inscriptions whether the Guptas had a Central Council of ministers (*Mantri-Parishad*).⁴⁴ The *Sabhyas*,⁴⁵ mentioned in connection with the selection of Samudragupta by his father, may have been the members of the king's council (or the council of ministers). But we have some positive references to the council of ministers in the *Nitisāra* of Kāmandaka. Regarding the number of ministers of the council, 'Manu says twelve, Brihaspati says sixteen, and Usanas says twenty ministers should form a cabinet. Others again say that as many good and deserving counsellors as are available should be admitted into the cabinet. Duly entering the cabinet and with mind undivided, a king should hold counsel for facilitating the successor of an act or undertaking'.⁴⁶ Moreover, 'the King seeking his own welfare should discuss the subject of a consultation separately with each of his ministers. After that he should take into serious consideration the opinion of each by itself'.⁴⁷ Thus, in every matter, the king should consult his wise ministers.⁴⁸

At the head of the judiciary stood the king himself. He was assisted by the *Mahādaṇḍanāyaka*.⁴⁹ Besides that royal court there must have

Other officials of the Central Government: *Mahādaṇḍanāyaka* (the great administrator of justice).

been courts for the administration of justice in the provinces and in the districts, and this work seems to have been entrusted to *Uparikas* and *Vishaya-patis* respectively. Petty cases in villages were usually decided by the headman and the village elders. Fa-hsien states that the king governs

without decapitation or other corporal punishments. Criminals are simply fined, lightly or heavily, according to the circumstances of each case. Even in cases of repeated attempts at rebellion they only have their right hands cut off.⁵⁰ But it is difficult to rely on his evidence in this matter, for

⁴⁰ Fleet, pp. 25, 35.

⁴¹ Kāmandaka, IV, pp. 25-26.

⁴² Fleet, pp. 25, 35.

⁴³ Dr. Roychaudhuri—*Political Hist. of Ant. Ind.*, p. 471 (4th ed.).

⁴⁴ Fleet, p. 44—The Bilsad inscription refers to a (*Pa*)-*rshad*.

⁴⁵ *Ibid.*, p. 6.

⁴⁶ Kāman., XI, pp. 74-75.

⁴⁷ *Ibid.*, p. 77.

⁴⁸ *Ibid.*, pp. 77-85.

⁴⁹ Fleet, p. 6; some scholars think that he was the chief military official of the State.

⁵⁰ Fa-hsien, p. 35 (Peking, 1957).

many of his observations are either wrong or exaggerated.⁵¹ Moreover, all our law-givers testify to the severity of the penal code.⁵²

*Mahāpratihāra*⁵³ was another high official of the State. He was undoubtedly the chief of the palace guards and of the royal bodyguards in particular.

The king had to maintain a great establishment for food. In the Maurya royal kitchen several hundreds of animals were daily sacrificed for food and a group of officials must have been engaged for its management. Unfortunately further details regarding the kitchen staff are not available. But in a Gupta inscription mention is made of an officer designated *Khādyaṭapakika* who may have been the superintendent of the royal kitchen.

Espionage probably continued to form an important feature of the administrative system in the Gupta period. In the early period Megasthenes, Kauṭilya and Aśoka inscriptions have left an interesting account of the espionage system in the Maurya period.

A class of men called overseers had to 'overlook what is done throughout the country and in the cities and make report to the king'.⁵⁴ Strabo calls them inspectors. He says: 'They are entrusted with the superintendence of all that is going on, and it is their duty to report privately to the king. The best and the most faithful persons are appointed to the office of inspectors.'⁵⁵

It may not be wrong to suppose that the Gupta kings also realized the necessity of collecting secret information with the help of spies, although their inscriptions do not record any definite information about the espionage system. Kāmandaka, however, has discussed the topic quite exhaustively, which may show that espionage as a system was not unknown in his time.⁵⁶

As regards the qualification of a *Dūtaka* (spy), 'a person skilled in the interpretation of internal sentiments by conjecture and by external gestures, accurate of memory, polite and soft in speech, agile in movements, capable of bearing up with all sorts of privations and difficulties, ready-witted and expert in everything, is fit to be a *Dūtaka*'.⁵⁷ Intelligent *Dūtakas* (spies) disguised as ascetics, traders or artisans should go out in all directions to acquaint themselves with the public opinion on all matters. They should then report it to the king. Even they should be posted in enemies' country for the necessary information to their royal master. They are thus called 'the eyes of the king'.⁵⁸ We have a reference of Vijayasena as a *Dūtaka* (reporter or spy) of Vanyagupta.

The military department was a vital part of the Gupta administration. The early Guptas must have devoted special attention to the task of devel-

Military organization. oping their military organization and resources and improving the efficiency of their army, which accounts for the great success of their policy of imperial expansion.

The Gupta emperor was, of course, the supreme head of the army. He was assisted by the *Samdhivigrahika*⁵⁹ who was the minister for war and peace. He was also helped by a group of high military officials.

⁵¹ *Eco. Life of N. India in the Gupta Period*, ch. III (at the end).

⁵² Kauṭilya, Manu, Nārada, Brihaspati and others.

⁵³ Gunaighor grant of Vanyagupta, *Ind. Hist. Quart.*, VI, p. 53.

⁵⁴ Chinnock, *Anjan*, p. 413.

⁵⁵ Kāman., XII, pp. 1-49.

⁵⁶ *Ibid.*, XII, pp. 26-27, 31-32, etc.

⁵⁵ Strabo, III, p. 103.

⁵⁷ *Ibid.*, XII, p. 25.

⁵⁸ Fleet, p. 6.

The *Mahābalādhikṛita*⁶⁰ was undoubtedly the commander-in-chief of the royal army. The royal army consisted of infantry, cavalry, navy and elephants. There was a very good standing army, drawing liberal and regular pay and supplied by the government with horses, army equipment and stores. Sometimes, hired soldiers were also appointed to meet the special need of the time.⁶¹

There were two other important officials in the military department. The *Mahāpilupati*⁶² was the head of the elephant force and most probably the *Bhogika*⁶³ (keeper of horses) was in charge of the royal cavalry.

The army was equipped with various weapons, both offensive and defensive. Battle-axes, bows and arrows, spears, pikes, barbed darts, swords, lances, javelins, iron arrows and many other weapons were used in warfare.⁶⁴

The army thus organized proved extremely formidable and the military successes of Samudragupta, Chandragupta II, Kumāragupta I and Skandagupta bear ample testimony to its efficiency.

Land was the bed-rock of the Gupta economy. The main source of wealth and the chief support of life are India's rich soil, river system, mountain ranges and seas. That is why the Gupta emperors took special care of the land administration of the country.

Land administration and royal treasury.

The term *Akshapaṭalādhikṛita* is generally interpreted as meaning the keeper of the royal records.⁶⁵ If he is the same as the *Akshapaṭalādhaksya* of Kautilya, his duty was to enter numerous matters in the accounts, recover the royal dues from the sureties or servants, to check embezzlement and to recover fines for loss due to neglect or fraud.⁶⁶ Though the functions of the *Akshapaṭalādhikṛita* cannot be definitely ascertained for lack of detailed information, it is probable that he had important duties connected with the land administration of the country.

Gopasvāmin was the *Akshapaṭalādhikṛita* of Samudragupta. He ordered the royal scribe to inscribe the Gaya copperplate of the king.⁶⁷

The more prominent high officials in the department of land administration were the *Pustapālas* (record-keepers) who had their offices at the centre as well as in the provinces and districts.

Pustapāla's department. They had to discharge various duties in connection with private and State lands. On the occasion of a land transaction the office of the *Pustapālas* used to make necessary enquiries as to the ownership of the land particularly involved, the aim and object of the intending purchaser, etc. Sometimes, there were more than one record-keeper⁶⁸ conducting such enquiries. But it was not arranged smoothly. Sometimes disagreement may have occurred. In one of the Damodarpur copperplates there is a case where there may have been a slight disagreement between the *Visayapati* and the *Pustapālas*. Apparently some objection might be raised either by the office of the *Pustapālas* or by the district governor. In a case where no objection was raised by any party the department of land records gave its consent to the proposed transaction.

⁶⁰ *Ep. Ind.*, XXV, p. 52; XXVI.

⁶¹ *Nar.*, V, p. 23; and *Bri.*, XV, p. 13.

⁶² *Ep. Ind.*, XXV, p. 52; *Ind. Hist. Quat.*, VI, p. 53.

⁶³ *Ind. Hist. Quat.*, VI, p. 53.

⁶⁴ Fleet, p. 6; *Kālidāsa's Works*.

⁶⁵ *Ep. Ind.*, XXV, p. 52; *Select Ins.* (Dr. Sircar), p. 264, f.n. p. 7; Fleet, p. 256.

⁶⁶ *Arth.*, 11.7.

⁶⁷ Fleet, p. 256; *Ep. Ind.*, XXV, p. 52.

⁶⁸ *Eco. Life of N. India in the Gupta Period*, Appendix II.

⁶⁹ *Ep. Ind.*, XV, pl. 5, p. 143.

After the consent from the *Pustapāla's* department was received, the applicant used to pay the usual price in cash to the district office.⁷⁰ The plot was inspected by the Local Council. The land was then demarcated according to the standard measure. Finally the City Council declared the sale as completed and had the transfer recorded in the usual form.⁷¹

From a careful study of the contemporary inscriptions it is quite clear that the State maintained a regular department for the proper survey and measurement of land as well as for the collection of land revenue. In the three copperplate grants⁷² of Dharmāditya and Gopachandra mention is made of lands being measured by the length of the *hasta* of upright Śivachandra. It is elsewhere stated that land was measured according to the length of the *hasta* of Darvikarmā.⁷³ From these inscriptions it is quite clear that Śivachandra and Darvikarmā were not record-keepers, for the record-keepers are separately mentioned.⁷⁴ They were probably the royal surveyors of land or officers in some way connected with the fiscal department of the king, for we see that in the three grants of Dharmāditya and Gopachandra only the measure of Śivachandra's *hasta* was accepted as a standard measure in a certain locality. The view that the length of the forearm of the officer was taken as the unit of land measurement may not be acceptable everywhere. Śivachandra was apparently the keeper of the standard measuring rod used in the locality, and was officially responsible for land measurement.

Kāmandaka suggests that a monarch should take special care of his treasury, for the life of the State depends solely upon it.⁷⁵ His expenditure

Royal treasury: Land
revenue.

should not be extravagant and he should personally inspect the treasury. These principles were probably followed in our period, for we read in

Kālidāsa of wealth being carried by hundreds of mules and camels from the royal treasury when Raghu donated fourteen crores of coins to a Brāhman.⁷⁶ This is certainly an exaggerated statement, yet there may be some truth in it, for we have seen that Samudragupta successfully launched vast campaigns over the major part of India.⁷⁷ These must have needed a sound treasury and a good army to back up his cause. It is also possible that his great southern expeditions had as their main motive the filling up of his treasury to provide resources for his more important expeditions in the west.

From the numerous references from the contemporary records it may be seen that land revenue formed the greatest source of wealth to the State. Generally speaking, the State claimed one-sixth of the produce of the land as its share. The State claimed it in return for the protection of life and property granted to it. This is called the subsistence allowance (*Vṛttih*) of the king. The account of Kālidāsa is fully corroborated by Nārada, who states that one-sixth of the produce of the soil forms the royal revenue. It is taken as the reward of the king for the protection of his subjects.⁷⁸

N.B.—For the detailed treatment of land administration, land revenue, etc. vide *Economic Life of Northern India in the Gupta Period*—Dr. S. K. Maity. (1st ed., pp. 9-70).

⁷⁰ *Ep. Ind.*, XV, f.n. p. 68.

⁷¹ *Ibid.*, XX, p. 59; *Eco. Life*, Appendix II.

⁷² *Ind. Ant.*, 1910, p. 195, pls. A, B, C.

⁷³ *Ep. Ind.*, XXI, p. 82.

⁷⁴ *Eco. Life*, Appendix II.

⁷⁵ Kāman, V, p. 77; Manu, VII, p. 65; Raghu, XVII, pp. 60, 81.

⁷⁶ Raghu, V, pp. 21, 32.

⁷⁷ *Ibid.*, II, p. 66; XVII, p. 65; *Sak.*, II, p. 850; V, p. 911 (Beng. Ed.—Chakravorty, S. C.).

⁷⁸ *Nar.*, XVIII, p. 48.

But no Gupta inscription directly states the proportion demanded in practice. But from the Baigram and the Paharpur copperplates⁷⁹, which give to the king one-sixth of the religious merit accruing from a donation, we may assume that this proportion represented the standard rate in our period. Besides this there were various other taxes and royal dues, such as *udraṅga*, *Uparikara Kṛpta*, *Upakṛpta*, *hiranya*, *kara*, *bali*, and the supply of forced labour (*viṣṭhi*) and dairy produce.⁸⁰

During this period not only the agriculturists but also the artisans had to pay taxes to the State.⁸¹ But we do not know in what way or to

Miscellaneous taxes. what extent they were taxed. Another important fiscal due mentioned in the *Amarakośa*⁸² is *Śulka* (tolls and customs). The existence of this is attested by some epigraphic evidences. Some of the inscriptions simply record the fiscal term *Śulka*.⁸³ The Bihar stone pillar inscription of Skandagupta⁸⁴ mentions the name of a collector (*Śaulkika*) of *Śulka*. According to Fleet the *Śaulkika* is the official title of the superintendent to tolls or customs. The second plate of Dharmāditya⁸⁵ mentions Gopāla-svāmin as a customs officer. In the opinion of Pargiter, he used to control trade. Probably he used to levy taxes and collected State dues on merchandise from traders and merchants. In the Faridpur grant of Gopachandra a similar kind of official is referred to.⁸⁶ Thus he is the same as the superintendent of tolls and customs of the *Arthaśāstra*.⁸⁷

Another source of the king's wealth was treasure-trove deposits, mines and the digging of salt, all of which exclusively belonged to the State. There are many indirect references to this kind of wealth.⁸⁸

In our period a substantial income accrued to the State from fines imposed on thieves and wrongdoers. Nārada and Brihaspati give ample evidences regarding this item and in many of our inscriptions fines imposed on criminals are mentioned.⁸⁹

From the above analysis we see that in the Gupta period there were several impositions besides the usual one-sixth—customary due. (Of course, it is true that the *bhāga-bhoga*, *Kara*, *hiranya*, *Suvarṇa*, *dhānya*, etc. do not imply different impositions.) Thus the early Gupta emperors had a very good income from a large variety of sources, accounting for their all-round success in different fields of activity.

PROVINCIAL ADMINISTRATION

The empire was divided into a number of provinces. The provinces were called *Deśas* or *Bhuktis* and were governed by *Uparikas*. Sometimes the princes of the royal blood, called *Kumāramatyas*, used to govern the provinces. The *Uparika* may represent the *Prādesikas*⁹⁰ of the Aśokan epigraphs and the same as the *Amātyas* of the Sātavāhana provinces.⁹¹

⁷⁹ *Ep. Ind.*, XX, p. 63; XXI, p. 81.

⁸⁰ *Eco. Life of N. India in the Gupta Period*—'Land Revenue' Section.

⁸¹ Fleet, p. 257 (Gaya C. P. of Samudragupta).

⁸² *Amar*, 8.28, p. 181 (Sharma and Sardesai Ed.—Poona).

⁸³ Fleet, pp. 246, 122.

⁸⁴ *Ibid.*, p. 50.

⁸⁵ *Ind Ant.*, 1910, p. 200.

⁸⁶ *Ibid.*, p. 204.

⁸⁷ *Arth*, XXI; XXII, p. 121.

⁸⁸ *Ep. Ind.*, XV, p. 42; *Ind. Hist. Quat.*, XVII, p. 115; Fleet, pp. 193, 198, 238, 246. *J.A.S.B.* (N.S.), XX, p. 53.

⁸⁹ Fleet, pp. 108, 115, 118, 122, 238, 247; *Ep. Ind.*, VIII, p. 287; *J.A.S.B.* (N.S.), XX, p. 53, etc.

⁹⁰ *Arth*, pp. 142, 217 (1st Ed. Eng.); Hultzsch—R. E. 111, p. 4.

⁹¹ Nasik Cave Ins. (*Ep. Ind.*, VIII).

For political and economic considerations Saurashtra was considered as one of the most important provinces in the Gupta empire. That is

why, a very able man, Parnadatta, was selected by His qualifications. Skandagupta. Regarding his ability and qualifications, Skandagupta says: 'Among all my servants put together who is there who is suitable, endowed with intellect, modest, possessed of a disposition that is destitute of wisdom and money, endowed with truth, straightforwardness, nobility and prudent behaviour and possessed of sweetness, civility and fame—loyal, affectionate, endowed with many characteristics, possessed of a mind that has been tried and is found to be pure by all the tests of honesty, occupied with the welfare of all mankind, capable both in the lawful acquisition of wealth and also in the preservation of it when acquired, and further in causing the increase of it when protected, and able to dispense with it on worthy objects when it has been increased—shall govern all my countries of the Saurashtras? I have it, there is just one man, Parnadatta, competent to bear this burden.... And just as the gods became comfortable and not disturbed in mind when they had appointed Varuṇa to the western point of the compass, so the king felt greatly relieved after appointing Parnadatta'⁹² as the governor of Saurashtra, who had all the requisite qualifications for this highly responsible post. His functions were thus executive and judicial.

DISTRICT ADMINISTRATION

For the betterment of administration the provinces were again divided into districts, called *Vishayas*. There were quite a large number of *Vishayas* in the Gupta empire. Each *Vishaya* was administered by a royal official, known as *Vishayapati*, and his office was known as the *Adhishthāna-Adhikarana*⁹³ (district head office). He was generally appointed by the governor of the *Bhukti*. Kumāramatyā Betravarman was appointed by the provincial governor to the *Vishaya* of Kotivarsha.⁹⁴

In his district head office (*Adhishthāna Adhikarana*), Betravarman was assisted by a group of representative people, viz. *Nagara-Sreshthi* (chief merchant of the town), *Sarthavāha* (chief caravan trader), *Prathama-Kulika* (chief artisan), and *Prathama-Kāyastha* (chief scribe).⁹⁵ In every important administrative business they used to assist the royal official of the district.⁹⁶

VILLAGE ADMINISTRATION

A district had so many villages within it. A village was the unit of administration. The administrative and judicial business of villages were carried on by the *Grāmika*.⁹⁷ He was assisted by a group of village elders, such as *Kuṭumbikas*, *Mahattaras*, etc.⁹⁸ According to *Asthasāstra*,⁹⁹ the *Grāmika* was not a paid servant of the crown but an elected official of the villagers. The royal servant in the village was the *Grāma-Vridha*.¹⁰⁰

⁹² Fleet, p. 58.

⁹³ *Ep. Ind.*, XV, 5 pls., p. 130; XXI, p. 81; XX, p. 61; *Ind. Hist. Quart.*, VI, p. 53; etc.

⁹⁴ *Ibid.*, XV, p. 130.

⁹⁵ *Ibid.*, XV, p. 130 (5 pls.); XX, p. 61; XXI, p. 81; *Indian Antiquary* (1910), p. 195 (Vol. 39).

⁹⁶ *Eco. Life of N. India in the Gupta Period—II* (Land sale), etc.

⁹⁷ *Ibid.*, f.n. p. 95 (XV).

⁹⁸ *Ibid.*, f.n. 95.

⁹⁹ *Arth.*, pp. 48, 161, 168, 169, 178 (1st ed.); Lüders, No. 1327.

¹⁰⁰ *Ibid.*, pp. 175, 248 (1st ed.).

But Manu¹⁰¹ seems to suggest that he was the king's representative in the villages.

The Gupta king thus controlled the whole machinery of the government and had the largest share in the formulation of the policy. He wielded very extensive powers, commanded the army, administered justice, issued rescripts and granted remission of taxes. But he could not be a despot always, for many of the laws of the land had a sacred character, being derived from the Vedas and Smritis, and were to a certain extent independent of the royal control. Besides these many of the ordinary secular laws were originated from the guilds and corporations and local customs.

The king, however, maintained a hierarchy of administrative set-up through the provincial heads. Provincial governors were directly appointed by the king and were responsible to him in the administrative affairs. Through him the king also influenced the district administration, for the *Vishayapatis* were again appointed by the *Uparikas* (governors).

Under ancient conditions the king was supposed to be the military lord of the State. He had to depend largely on the military strength of the State for the preservation and extension of his kingdom. But there may have been some shortcomings of the military administration. Not only that, the whole administrative set-up depended largely on the personality and valour of the king. As long as the great kings like Chandragupta I, Samudragupta, Chandragupta II, Kumāragupta I and Skandagupta were ruling the empire, the people enjoyed peace and prosperity in Gupta India. But after their death the great Gupta empire was destroyed like a house of cards. Forces of disintegration continued right up to the establishment of British power in India. But in contemporary China one dynasty succeeded another, and even in case of the division of the empire and the secession of provinces from the central control, the empire ultimately survived and maintained its existence.^{101a} On the other hand, in India the empires under the Mauryas, Kushāṇas, Guptas, Pālas, Rāshtrakūṭas, Cholas and many others vanished altogether within a few centuries of their foundation, although many of the kings of these dynasties were great conquerors and administrators as well.

According to Dr. A. L. Basham,¹⁰² they failed to establish an adequate administrative set-up. Moreover, 'in both India and China civil servants were selected by examination, but the examination system of ancient India was merely the testing of the honesty and loyalty of the servant of the State by means of spies and *agents provocateurs*. The textbooks on polity regularly advised that all bureaucrats should be continually watched by spies. In such circumstances an atmosphere of suspicion and mistrust must have prevailed throughout the civil service of the ancient Indian kingdom and led to inefficiency and lack of initiative.' It would thus 'seem that the Indian bureaucrats, even under the Mauryas', Guptas and many others, 'never achieved the comparatively high standards of efficiency and probity reached by the Chinese mandarin, trained in the political ethics of Confucius'.¹⁰³

¹⁰¹ Manu, VII, pp. 115-119.

^{101a} As f.n. p. 102.

¹⁰² *The Indian Sub-continent in Historical Perspective*, pp. 10-11. (Pub. School of Oriental and African Studies, London Uni.).

¹⁰³ *Ibid.*

WILLIAM CAREY AND PANDIT VAIDYANATH

By A. K. MAJUMDAR

(Paper received on 18th October, 1960)

While going through the proceedings of the Fort William College, I came across several letters and resolutions which throw some light on a little known Marathi scholar named Vaidyanath.¹ As I am not a student of the Marathi literature, it is not possible for me to assess the value of Vaidyanath's works, but the evidence which I have come across leaves no doubt of the importance of the help which he rendered to William Carey, who occupies an important place in the development of modern Marathi. This fact is more or less known and Prof. Bhate writes: 'Dr. Carey was assisted in all his literary work in Marathi by a Pandit named Vaidyanath.' Prof. Bhate then adds: 'Dr. Carey published in all about 10 books in the Marathi language such as *Simhasanabattisi*, a history of Raja Pratapaditya, and the genealogy of Raghoji Bhosale.'² This statement gives scant recognition to Vaidyanath. As the letters will show, the *Simhasanabattisi* and the *Life of Raja Pratapaditya* were translated by Vaidyanath, and Carey had nothing to do with the preparation of these books, except that he published these books from his press at Serampore, and induced the Fort William College to subscribe for 150 copies of each book. Vaidyanath also wrote the genealogy of Raghoji Bhosale and translated the *Hitopadesa* into Marathi.

It has sometimes been assumed that from the beginning of his career at the Fort William College, Carey had been teaching Marathi. But the facts are that even in February 1803 there was no provision for teaching Marathi in the Fort William College, and one R. Jenkins was granted Rs.30 per month for payment to his private Marathi tutor.³ Next year Vaidyanath was appointed on Carey's recommendation on a salary of Rs.100 per month.⁴

It should be noted that even when Vaidyanath was appointed, few students offered themselves for the study of the Marathi language at the Fort William College. A few years later a similar college was opened at Bombay, and since then we do not find in the Proceedings of the Fort William College the record of any Marathi examination. But probably some instruction was given, particularly to military students, and we find Carey writing to the Council of the College on 2nd February, 1816: 'As long as the Marhatta Language is taught in the College there will be a necessity for a Pundit of that language. Vaidyanath has ably performed his duties of his office from the time of his first appointment till the present time. His allowance was formerly reduced from 100 Rupees per month to 80, and I think cannot with propriety be reduced further.'⁵

¹ G. C. Bhate in his *History of Modern Marathi Literature, 1800-1938* (1939), p. 69, gives the name as Vidyantath. But from the different spellings in the Proceedings of the Council of the Fort William College, the name appears to be Vaidyanath. Roebuck in his *Annals of the College of Fort William*, Appendix III, p. 50, writes the name in Nagri as Vaidyanath.

² Bhate, *op. cit.*, p. 69.

³ *Home Misc. No. 559*, Proceedings of 7th March, 1803, pp. 151-52.

⁴ See below Letter No. I.

⁵ *Home Misc. No. 563*, pp. 592-93.

It seems that, though working under Carey, Vaidyanath conducted the Marathi classes practically alone. Carey was almost always officially designated as 'Professor of Sanskrit and Bengali'. In a report regarding the working of the College, dated 31st October, 1818, Carey as usual is described as the Professor of Sanskrit and Bengali, and a marginal note adds: 'Dr. Carey also gives occasional instruction when called for in the Marhatta language.'⁶

It has sometimes been stated that Carey's original salary of Rs.500 per month was increased to Rs.1,000 when the teaching of Marathi was added to his duties.⁷ But that is not the case. Salary of the Professors of the Fort William College was Rs.1,000 or more but Carey being a Non-conformist was disqualified to hold the post of a Professor under the following clause of the Statute of the Fort William College: 'all the superior officers, the professors, and lecturers solemnly and faithfully to promise and declare they would not maintain publicly or privately any doctrines or opinions contrary to the doctrine or discipline of the Church of England.'⁸ To meet the case of Dissenters and Roman Catholics, a lower class of officers was created, from whom no such declaration was required, and whose allowances were fixed at a maximum of Rs.800 a month. Carey was called 'Teacher of Bengali' and not 'Professor' like his colleagues.

Later, Carey submitted the following application to the College Council⁹:

GENTLEMEN,

I beg leave to submit to your consideration the following circumstances respecting my situation in the college of Fort William.

At the commencement of the Institution, I was engaged to teach the Bengalee language on a salary of 500 Rupees per month. I had also the use of an apartment in the college, and, while the Public Table was continued, had also the benefit of that.

I have since been employed to teach the Sanskrit and Mahratta languages, and have composed Grammar in the above three languages for the use of the Students.

During the first years of the College the Bengalee was not so much studied as it is at present. I have now generally a class nearly as numerous as the Persian and consequently an increase of labour. I am obliged to hire accommodation at Calcutta, to provide a table and to keep a horse to convey me from my residence at Serampore to the College.

As the cultivation of the Bengalee language is deemed by the Honourable Court of Directors of great importance to the public services, I humbly hope the Governor General in Council may not deem it improper to place

⁶ *Home Misc.* No. 565, p. 251.

⁷ A. K. Priolkar: *The Printing Press in India* (Bombay, 1958), p. 62.

Sri Sajani Kanta Das in his Bengali biography of Carey (*Sāhitya-Sādhaka-Charitāmālā*, No. 15, p. 25) refers to a letter from Carey to one Sutcliffe in which it is said to have written that as a result of his becoming the teacher of Marathi his salary was increased by Rs.200 to Rs.700 some time in 1804. Sri Das neither quotes the letter nor gives any reference, so that it is impossible to check this statement. But from the records of the Fort William College this does not appear to be correct, and Carey's application given below tends to show that his original salary had not been increased till the date of the application, namely 19th August, 1806. I am therefore unable to believe Sri Das's statement until Carey's original letter to Sutcliffe is produced.

⁸ J. C. Marshman: *The Life and Times of Carey, Marshman, and Ward* (London, 1859), I, p. 149.

⁹ *Home Misc.* No. 560. *Proceedings of 27th August, 1806*, pp. 166-67.

the Bengalee Teacher on a footing with the other Teachers in the Hindoostanee and Persian Departments.

I commit my case, Gentlemen, to your attention, and request, if you approve, it may be stated by you to the Hon'ble the Governor General in Council.

August 19, 1806.

I have the honour to be,
Sir,
Your faithful servant,
W. CAREY.

The application was considered favourably and Carey's salary was increased to Rs.1,000 per month. But it is evident from this application that the increment had little to do with the teaching of Marathi.

As has been stated above, Vaidyanath translated the *Life of Raja Pratapaditya* and some other works which are now ascribed to Carey. But he also seems to have collaborated with Carey in preparing the Marathi Bible and the Grammar to such an extent that some credit is due to him. Shortly after the Fort William College was started (1801), the Serampore missionaries began to plan to translate the Bible in the principal languages of India, and Marshman, Carey's biographer, states that they submitted their plan for approval to the Society in England at the commencement of 1804. One of the reasons which led the missionaries to plan so ambitiously was, as Marshman puts it, that '... they were in a position, by Mr. Carey's connection with the college, to obtain the assistance of learned men from all these countries' ¹⁰ (Madras, Maharashtra, etc.). It is apparent from Carey's letter ¹¹ that such indeed was the case, and he found Vaidyanath's help in translating the Bible to be so useful as to recommend him for a post in the Fort William College and start the Marathi department. The financial condition of the Serampore Mission was never very sound, and this was probably the only way in which Carey could pay Vaidyanath an adequate salary. Apparently Vaidyanath had been engaged in translating the Bible for about six months before his appointment to the College. For, in a letter dated 7th September, 1803, Carey states that a Marathi Pandit was translating the Bible,¹² and it may be presumed that this Pandit was Vaidyanath. Thus it may be concluded that after Vaidyanath had translated the Bible into Marathi for six months to Carey's satisfaction, the latter found for him a suitable employment in the Fort William College. The Marathi Bible was, however, known as Carey's work, but years later, when some of Carey's translations were criticized for defective language, it was pointed out that '... the Mahratta version was more likely to be free from such inaccuracies than several others. It was executed under the eye of the Mahratta Pundit attached to the college of Fort William, who had been selected for the office, amid many competitors, for his superior attainments in oriental philology'.¹³

Regarding Carey's celebrated Marathi Grammar, Marshman writes: 'Lord Wellesley had determined to introduce the study of Mahratta into the College, for the benefit of the students from the Bombay Presidency; that language was therefore added to the list of translations, and Mr. Carey began the compilation of a Mahratta grammar.'¹⁴ From this statement it would appear that Carey alone had compiled the grammar. But, the

¹⁰ Marshman, *op. cit.*, I, pp. 193-94.

¹² Quoted by Priolkar, *op. cit.*, p. 61.

¹⁴ *Ibid.*, I, p. 194.

¹¹ Letter No. I—see Appendix.

¹³ Marshman, *op. cit.*, II, pp. 445-46.

College Council Proceedings of 20th September, 1804, records a list of works in oriental languages prepared or under preparation by members of the College staff. Some of these works had already been published and others are stated to be 'in the press'. In the latter group we find the following entry: 'Mahratta, preparing for the press, a grammar of Marhatta by Vydunath Marhatta a Pandit in conjunction with W. Carey.'¹⁵ This statement must have been supplied to the College Council by Carey. It therefore becomes somewhat difficult to explain his subsequent statements made to the Council. For example, in a letter written to the College Council on 3rd September, 1805,¹⁶ Carey states that he had written the grammar. Again in his application for an increased salary, quoted above, he makes the same claim. Carey was a man of unexceptional probity and one cannot impute any dishonest motive to him. But on the available evidence the only possible conclusion is that both the Bible and the Marathi Grammar were the joint works of Carey and Vaidyanath, but the scheme and the final decision being Carey's, he could claim the authorship. Secondly it may be suggested that no Englishman in the days of Lord Wellesley would be disposed to associate his name with people, whom even a humanitarian like Carey habitually referred to as 'natives'.

About the authorship of the other works, namely the *Buttis-simhasana*, the *Hitopadesa* and the *Life of Raja Pratapaditya*, there is no doubt. Vaidyanath translated all the three as Carey repeatedly pointed out in his letters,¹⁷ though in the later Proceedings of the College Council, Carey is invariably shown as the author. Apparently the title-page contained Vaidyanath's name only, for Roebuck describes him as the author of these books. Roebuck, however, ascribes to Carey the compilation of a book of Marathi letters. But this book seems to have been the one written by one Vitthal Pandit, who was for some time employed in the Fort William College as a Marathi writer as mentioned in Carey's letter of 13th June, 1814.¹⁸ Nothing more is known about this Vitthal Pandit.

About Vaidyanath also we know very little. In the report on 'Establishment of the office of the College of Fort William as it stood on the 1st of November 1816', Vaidyanath's age is given as 55.¹⁹ But this list is not free from error as his date of joining the college is shown as September 1801. He joined the Fort William College in 1804, and, presuming his age given in the above-mentioned list to be correct, was at that time about 40 years old. Carey testifies that he knew Marathi, Bengali and Hindusthani (i.e. Urdu) quite well, and had a 'tolerable knowledge of Sanskrit, Persian and Uriya'. Carey also certifies that he was 'well skilled in collateral tongues',²⁰ by which he probably means Konkani and Gujarati. This testimony coming from a linguist of Carey's calibre must be taken as a proof of extraordinary abilities. Few Indian scholars today know so many languages.

Carey was extremely devoted to Vaidyanath. When there was an economy drive in the College, Vaidyanath's salary had to be reduced to Rs.80. But later Carey tried to abolish the post of a Bengali writer, and restore Vaidyanath's former salary. The Council, however, did not accept Carey's proposal, but Carey did not allow any further cut in Vaidyanath's salary.

As mentioned above, Vaidyanath translated the Bengali book, *Raja-Pratapaditya-charita*, into Marathi in 1805. This book has the distinction

¹⁵ *Home Misc.* No. 559, pp. 352-53.

¹⁶ Appendix, Letter No. III.

¹⁷ Appendix, Letters Nos. IV and VII.

¹⁸ Appendix, Letter No. IV, for Roebuck, see above f.n. 1.

¹⁹ *Home Misc.* No. 564, p. 291.

²⁰ Appendix, Letter No. I.

of being the first modern Bengali prose work of importance to be printed, and if Carey is to be believed, Vaidyanath's work was 'the first effort which has been made to write elegant prose in that (Marathi) Language'.²¹ On Carey's recommendation the Council of the College awarded Vaidyanath a cash reward of Rs.300 for his translation.

We do not know exactly when, or under what circumstances, Vaidyanath left the College. In a return date, June 1819, Vaidyanath's name appears as a member of the staff. But in the next return, dated May 1820,²² his name is dropped. He must have left the College some time between June 1819 and May 1820.

LETTER FROM THE TEACHER OF THE BENGALEE AND SHANSKRIT LANGUAGES

To

The Council of the College of Fort William.

GENTLEMEN,

The Pandit Bydinath is well acquainted with the Marhatta, Bengalee and Hindostanee Languages and has a tolerable knowledge of the Shanscrit, the Persian and the Oorea. Should it be thought proper to appoint a chief Pundit in the Marhatta Language, I can recommend him as a very proper person, he being a Marhatta of a good family and well skilled in the collateral tongues. He was formerly Pundit to I. H. Lovett Esq. and is now employed by me in translating the Gospels into the Marhatta Language.

23 January, 1804.

I am,
Gentlemen,
Your obedient humble servant,
W. CAREY.

'Resolved that Bydanath Pundit be placed on the College Establishment with a salary of one hundred Rupees a month, as Teacher of the Marhatta Language under the Superintendence of Mr. Carey.'

(*Home Misc.* No. 559, p. 307.)

II

To

The Council of the College of Fort William.

GENTLEMEN,

The first Pundit in the Mahratta Language, Vydynath, has made translation of the *History of Raja Pratapaditya* from the original Bengalee into Mahratta. As this is the first effort which has been made to write elegant prose in that Language, and will be a very useful class book, I recommend it to your notice as an attempt for which it will be proper to

²¹ Appendix, Letter No. II.

²² *Home Misc.* No. 565, p. 419; No. 566, p. 116.

give some reward to the translation. I enclose the Manuscript for your inspection.

4th July, 1805.

I am,
Gentlemen,
Your most obedient servant,
W. CAREY.

(*Home Misc.* No. 559, p. 442.)

III

To

The Council of the College of Fort William.

GENTLEMEN,

In consequence of the office of teaching the Mahratta Language having been confided to me, I found it necessary to write and print a Grammar of it. This work having been undertaken solely for the benefit of the College and being a work, which from its nature must have a very confined sale, I take the liberty of soliciting the Council of the College to subscribe for a number of copies for the use of the institution.

I have prepared, and nearly arranged materials for a dictionary of the Mahratta Language, convinced that the progress which a student can make therein without that necessary help must necessarily be very slow. But it is necessary for me to state that it would be an highly improvident step for me to engage in the printing and publishing of it unless the Council of the College think proper to encourage it by subscribing for a number of copies. It is supposed that it will make 600 pp. in Octavo and may be sold for 16 Rupees a copy.

3rd September, 1805.

I am,
Gentlemen,
Obediently yours,
(Signed) W. CAREY.

(*Home Misc.* No. 559, p. 447.)

IV

To

Captain A. Lockett,
Secretary of the College Council.

Sir,

Lectures in the Mahratta Language being now established in the College, I request you will lay before the College Council the necessity of printing certain books in that Language for the use of the classes.

There is in the College Library a Volume of letters on various subjects written in Mahratta by Vittul Pundit who was formerly employed as a Mahratta writer in the College; and a translation of the *History of Raja Pratapaditya* [sic] from the Bengalee made by Vidyanath, the Chief Pundit in the Mahratta department. These will be two works proper for the study of the lower classes. To these I recommend the adding of the *Buttrish Singhasuna*, and the *Hitopadesha* for the higher classes. The two last may be translated by the Chief Pundit Vidyanauth [sic] as a part of his official duty.

I therefore request that these books may be printed for the use of the Mahratta class. At the same time I propose to undertake the printing of them if the College Council will subscribe or ensure a subscription for the hundred and fifty copies at the usual rate for a hundred pages.

A Pundit has written in the Bengalee Language a commentary on the *Bhagavat Geeta* which is well executed, and highly deserving of a reward, it being calculated to combine the study of the Bengalee Language with a valuable piece of assistance in the study of Sangscrit. I therefore request that a small reward not less than fifty Rupees be given him for the work. At the same time I propose to print the *Geeta* in Sanskrit with this commentary in the Bengalee Language at my own private expense, if the College Council have no objection to its being thus made public.

17th Feb., 1814.

I am,
Sir,
Yours obediently,
W. CAREY.

(*Home Misc.* No. 563, p. 67.)

To

Captain A. Lockett,
Secretary to the College Council.

Sir,

I will thank you to inform the College Council that the expense of printing 150 copies of the four works which I have recommended for the Mahratta Class will be as follows.

150 copies of Letters, pp. 100	325
150 copies of <i>History of Pratapaditya</i> , pp. 160	540
150 copies of <i>Buttrish Singasun</i> , pp. 200	670
150 copies of <i>Hitopadesha</i> , pp. 260	866

Rs.2,401

This calculation is made on the supposition that the works will be printed on the best Patna paper. If they are printed on English paper the expense will be increased in proportion to the goodness of the paper. Should the number of pages be fewer in the Mahratta than in the Bengalee,

from which this calculation is made, the price of the works will be proportionably reduced and vice versa.

4th March, 1814.

I am,
Sir,
Yours obediently,
W. CAREY.

(*Home Misc.* No. 563, p. 68.)

VI

To

C. M. Rickets, Esqr.,
Secretary to the Government.

Sir,

Some Military students having been lately permitted to study the Mahratta Language in the College, and Books in that Language being in consequence much required Mr. Carey, the Sanskrit and Bengalee Professor, has submitted a proposal for translating and publishing at the expense of the Government 150 copies of each of the following works. The whole to be printed on the best Patna paper at the following rates.

150 copies of Letters, pp. 100	325
„ „ „ <i>History of Raja Pratapaditya</i> , pp. 160	540
„ „ „ <i>Buttrish Singhasan</i> , pp. 200	670
„ „ „ <i>Hitopadesha</i> , pp. 260	866
	<hr/>
	Rs.2,401

The Council of the College under the circumstances stated request that you will submit to His Excellency the Right Hon'ble the Governor-General in Council their recommendation that 150 copies of the above mentioned 4 works be subscribed for on the part of Government.

College of Fort William,
15th March, 1814.

I have the honour to be,
Sir,
Your most obedient servant,
A. LOCKETT,
Secretary, C.C.

(*Home Misc.* No. 563, p. 69.)

To this letter the Secretary to the Government replied on March 25, 1814, agreeing in principle to the proposal but suggesting that instead of 150 copies 100 may be subscribed. To this Carey replied.

(*Home Misc.* No. 563, p. 70.)

VII

To

Captain A. Lockett,
Secretary to the College Council.

Sir,

I had two reasons for recommending a Subscription of 150 copies of the four works requisite for the Mahratta class.

First: I understand there is a general order to send 50 copies of all Works subscribed for to the other Presidencies in which case the remaining fifty copies would be soon expended, and as it would not answer our purpose to print a superfluous number of Copies of Works which could not be in much demand the additional 50 copies would prevent the necessity of soon printing a second edition.

Secondly, the Mahratta language is but little studied at present, we therefore cannot reasonably expect to sell fifty copies besides those subscribed for by Government. But the subscription for 100 copies would scarcely be a remuneration for the necessary expenses for the Press, the subscription, however, for 50 additional copies will make it worth our employing the Press for that purpose.

I beg leave to observe that I made no proposal to translate. Two of the works proposed to be printed are in the College Library in MSS. and the Chief Pundit in the Mahratta department will translate the two others as a part of his official duty.

15th April, 1814.

I am,
Sir,
Obediently yours,
W. CAREY.

(*Home Misc. No. 563, p: 70.*)

Carey again wrote on this subject.

VIII

To

Captain A. Lockett,
Secretary to the College Council.

Sir,

In consequence of a doubt having been mentioned by you whether Government should subscribe for one hundred and fifty copies of the four Works recommended by me for the use of the Mahratta class (in which case we should not print more than two hundred copies in the whole) or whether a larger edition should be printed wholly at the expense of the Government, I take the liberty of enclosing the accompanying memorandum which will show the price at which we proposed to print the 150 copies and the additional expense of printing any given number of copies more than that number.

4th May, 1814.

I am,
Sir,
Yours obediently,
W. CAREY,

Memorandum sent to the College on 1st March, 1814.

	Rs. as. p.
150 copies <i>Mahratta Hitopadesh</i> , 260 pages including paper	866 0 0
150 „ Letters, 100 pages including paper	325 0 0
150 „ <i>Pratapaditya</i> , 160 pages including paper	540 0 0
150 „ <i>Buttrish Singhuson</i> , 200 pages including paper	670 0 0
Upon Patna paper for each hundred of the <i>Hitopadesh</i> beyond the 150 copies	70 0 0
„ Letters each 100	22 0 0
„ <i>Pratapaditya</i> each 100	35 0 0
„ <i>Buttrish Singhuson</i> each 100	44 0 0

If these Works be Printed on English Printing Demy, the Price of Paper for each hundred will be double that of Patna.

(*Home Misc.* No. 563, p. 71.)

IX

(The name of the person to whom addressed not given.)

MY DEAR SIR,

The College Council I believe has not come to any determination respecting the works to be printed for the use of the Mahratta class. A question I think was started whether Government should subscribe for 150 copies or take the whole impression amounting to any member (number) of copies, they may please to order. To enable the College Council to determine this question I some time ago sent to you an account of the additional expense of printing any number beyond the 150 copies.

I wish to remark that as we cannot expect these works to sell in the Market it will not be worth our while to set (?) the press for a smaller number than 150 copies, nor could we without loss print an impression of more than 50 copies more than are subscribed for by Government.

You will oblige me by bringing this matter to a termination as soon as possible, as the first sheet is composed, and cannot be printed off till the decision be known.

22nd July, 1814.

I am,
Very truly yours,
W. CAREY.

(*Home Misc.* No. 563, p. 175.)

X

To

Captain A. Lockett,
Secretary to the College Council.

SIR,

I do not recollect having before seen the remark on my letter to the College Council directed to you (on) April 15th which remark is dated July 20th and request me to state the rate of subscription for which we will engage to print one hundred copies of each of the Works required for the Mahratta class,

I beg to observe that the printing of one hundred copies for the college at the rate which I proposed for one hundred and fifty copies would not ensure us a profit sufficient to indemnify us for employing the press on so small an addition. If, therefore, the number subscribed for by the Government be only one hundred, the price for each copy must be augmented so as to be a sufficient indemnity.

In my memorandum of the additional expense of printing any given number of copies beyond the 150 which I at first recommended, I have stated that the additional expense of every hundred copies of

The <i>Hitopodesha</i> will be 70 Rupees)				
The Letter	do.	22	do.	if printed on
<i>Pratapaditya</i>	do.	35	do.	Patna Paper.
<i>Buttrish Singhasun</i>	do.	44	do.	

As the price of the paper is the only thing which would make any difference between the expense of printing one hundred copies, and one hundred and fifty, a deduction of half the sums calculated for every additional hundred will show the sum for which we can afford to print an addition of one hundred vizt.

<i>Hitopadesha</i> , 150 copies calculated	866	Rupees deduct 35 =	831 for 100 copies
<i>Pratapaditya</i>	do.	540	do. $17\frac{1}{2} = 522\frac{1}{2}$
Letters	do.	325	do. $11 = 314$
<i>Buttrish Singhasun</i>	do.	670	do. $22 = 648$

If these works would sell in the Market, I could have made a greater deduction, and, indeed, should not have asked for a greater subscription than is usual in such cases, but we cannot reasonably count on the sale of a single copy, and therefore must look to Government for a remuneration which the price above stated will be.

28th July, 1814.

I am,
Sir,
Obediently yours,
W. CAREY.

(*Home Misc.* No. 563, p. 176.)

XI

To

A. Trotter, Esq.,
Acting Secretary to the Government.

SIR,

I am directed by the Council of the College to acknowledge the receipt of Mr. Secretary Ricketts letter of the 25th March, and to transmit to you for the Orders of His Excellency the Vice-President in Council a Copy of Dr. Carey's letter of the 15th April explaining his reasons for proposing a subscription for 150 copies of the four *Mahratta Works* therein mentioned as also a copy of his letter of the 28th July stating the terms on which 100 copies may be furnished.

The difference of the subscription required for 150 or 100 copies of the four works proposed to be printed being 86 Rupees only, and as printed

Books in the Mahratta Language may be useful at Madras and Bombay, the College Council beg to repeat their recommendation that 150 copies be subscribed for at the stated charge of 2,401 Rupees.

College of Fort William
3rd August, 1814.

I have the honour to be,
Sir,
Your most obedient servant,
A. LOCKETT,
Secretary, C.C.

(*Home Misc.* No. 563, p. 177.)

In a letter dt. 9th August, 1814, the Government permitted the printing of 150 copies @ 2,401 Rupees as suggested by Carey.

(*Home Misc.* No. 563, p. 178.)

XII

To

A. Trotter, Esq.,
Acting Secretary to Government Public Department.

SIR,

One hundred and fifty copies of Dr. Carey's *Buttrish Singhasun* having been received into the College Library, I am directed by the Council of the College to transmit for the purpose of being submitted to the Honourable the Vice-President in Council the enclosed Bill for the same amounting to Sicca Rupees 616-6-6 being Rupees 53-9-6 less than the Estimate submitted to Government for the number of copies in question of this the Work, with their recommendation that it may be passed.

2. The *Buttrish Singhasun* is one of the four Mahratta Works, a Subscription for 150 Copies of which was authorised by Government in the 9th August, last.

College of Fort William
7th February, 1815

I have the honour to be,
Sir,
Your most obedient servant,
Th. Roebuck,
Actg. Secy., C.C.

(*Home Misc.* No. 564, pp. 309-10)

FLORAL ORGANOGENY AND DEVELOPMENT OF MALE AND
FEMALE GAMETOPHYTES IN TWO SPECIES OF
SCROPHULARIACEAE

By NIRANJAN PAL*

(Communicated by Sri S. K. Saraswati)

(Paper received on 4th January, 1961)

The family Scrophulariaceae has received much attention from the embryologists all over the world. A considerable amount of work on the embryology of this family has been done in India also. In spite of this, a large number of genera of this family still remain to be investigated; among them are *Lindenbergia* and *Mazus*.

L. indica (Linn.) Kuntze is a lithophyte, widely distributed in India and neighbouring countries. It appears to be a polymorphic taxon.

Mazus japonicus (Thunb.) Kuntze (*M. rugosus* Lour.), a small waste-place sciophytic weed of the monsoon, is also very widely distributed in India.

MATERIALS AND METHODS

Lindenbergia indica and *Mazus japonicus* were collected from various places in and around Calcutta during the rainy seasons. The larger flower buds and mature flowers were dissected before fixation in weak FAA; those of *L. indica* were treated with Carnoy's fluid (6 : 3 : 1) for a few seconds to facilitate proper penetration and later washed prior to fixation. Customary methods were followed and sections were cut between 7-11 microns in thickness. Heidenhain's and Delafield's haematoxylin were employed for staining the sections.

OBSERVATIONS

(i) *Organogeny of flower*

The sepals arise first as protuberances from the sides of the dome-shaped floral primordium (Figs. 1, 10). A second whorl of appendages soon becomes apparent above the sepals. As it grows, it gives rise to two concentric whorls which grow separately from each other. The outer members constitute the gamopetalous corolla and the inner differentiate into the epipetalous stamens (Figs. 2, 11). Next, the carpellary primordia originate. Thus, the order of development of floral organs is similar to other members of this family (Schertzer, 1919; Krishna Iyengar, 1940; Srinath, 1940; Srinivasan, 1940; Safeulla and Govindu, 1950; Pal and Pal, 1961).

(ii) *Microsporogenesis and development of male gametophyte*

The hypodermal archesporium differentiates in the four lobes of the young anther (Figs. 4, 12). In *Mazus japonicus* these cells are large in size and less in number. They divide periclinally followed by further periclinal divisions in the parietal cells (Figs. 4, 5, 12, 13). The cells of

* Biology Department, Maulana Azad College, Calcutta-13.

the outer layer divide again periclinally to give rise to the anther wall of four layers of cells, including the epidermis.

The endothelial cells at maturity show characteristic thickenings. The thickenings are perceptible at a late stage of development; at this time a few cells become biseriate and the inner smaller cells do not show thickening in their walls. The middle layer soon disorganizes and the innermost layer differentiates into the secretory tapetum. The tapetal cells become binucleate; in *Mazus japonicus* the two nuclei may fuse to form a large tetraploid nucleus (Fig. 14).

The primary sporogenous cells divide and become converted into microspore mother cells. They undergo reduction divisions and the microspores are arranged in a tetrahedral or rarely in an isobilateral manner.

The pollen grain during development is somewhat elongated and shows three alternate longitudinal ridges and furrows. Soon it becomes more or less spherical. The mature pollen grain is binucleate (Figs. 8, 16). Schnarf (1931), Srinath (1934), Milsaps (1936), Raghavan and Srinivasan (1941) and Tiagi (1956) also record binucleate pollen grains for other taxa of this family. The tricolporate pollen grain has spindle-shaped long colpa (Figs. 9, 17). It is psilate and oblate in *Lindenbergia indica* but finely reticulate and suboblate in *Mazus japonicus*. The average measurement of a pollen grain in the former is $20.5 \mu \times 15.0 \mu$ while in the latter it is $29.1 \mu \times 27.0 \mu$. The sexine in both is thicker than the nexine. Erdtman (1952) reports that the pollen grain in this family is 2-7 aperturate, peroblate to prolate in form and 11 μ to 45 μ long.

(iii) *Megasporogenesis and female gametophyte*

The papillate ovular primordium, originating on the thick axile placenta, gradually broadens and curves. Simultaneously, the single integument differentiates from the base of the nucellus.

The hypodermal archesporium of the tenuinucellate anatropous ovule differentiates early (Fig. 18). In *Lindenbergia indica* cases of multiple archesporium consisting of two juxtaposed or superposed cells were met with (Figs. 19, 20). Usually, only one develops further.

The archesporial cell enlarges and functions directly as the megaspore mother cell (Fig. 29). After the usual reduction division, a linear tetrad of megaspores is formed (Figs. 21-23, 32). In *Mazus japonicus* often a T-shaped megaspore-tetrad is noticed (Figs. 30, 31) as in *Pedicularis verticillata* (Schmid, 1906), *Moniera hamiltoniana* and *Bacopa hamiltoniana* (Safeeulla and Govindu, 1949, 1950).

The chalazal megaspore functions and the others gradually degenerate. The functioning megaspore enlarges and the nucleus after three successive divisions (Figs. 24, 25, 32-35) gives rise to an eight-nucleate embryo sac after the Polygonum type.

In the mature embryo sac the egg cell is large and pear-shaped (Figs. 36, 37). The synergids are smaller in size, but sometimes in *Mazus japonicus* they attain the dimensions of the egg cell (Fig. 37). Cases were noticed where the synergids were egg-like. The polar nuclei fuse and the secondary nucleus is situated very near the egg.

The antipodal cells are angular as in some other members of this family (Yamazaki, 1953, 1954, 1957b) and present a varied arrangement (Figs. 27, 36, 37) similar to *Pedicularis silvatica* (Berg, 1954). They persist for a considerably long period after fertilization. In *Mazus japonicus* they survive until the endosperm becomes 4-10-celled, whereas in *Lindenbergia indica* they remain intact still longer. Though persistent, the antipodals do not develop further.

Many growing embryo sacs were found to degenerate at various stages of development. In *Lindenbergia indica* the mature embryo sac is curved, and the curvature is more pronounced at the middle. The micropylar half of the embryo sac becomes much wider than the other end.

(iv) *Integumentary tapetum and the hypostase*

The nucellar epidermis degenerates during the development of female gametophyte and the innermost layer of the integument differentiates into the endothelium (Fig. 28). The uninucleate cells of this layer are filled with dense cytoplasm. This tapetal jacket encloses only the middle part of the embryo sac. In *Lindenbergia indica* the whole of the micropylar half of the embryo sac is left free. These tapetal cells remain active and intact for some time after fertilization; later they gradually become inconspicuous as the endosperm develops.

In *Lindenbergia indica* the cells adjacent to the chalazal end of the growing embryo sac gradually lose their protoplasmic contents and staining capacity. These radially elongated, thick-walled cells become highly refractive (Fig. 28). Further, in this species, some cells in the micropylar region which take a deep stain are digested by the growing embryo sac.

(v) *Fertilization*

Fertilization is normal and porogamous as in some other species of this family (Schnarf, 1931; Krishna Iyengar, 1937). The pollen tube enters into the embryo sac through one of the synergids (Fig. 38). The other synergid degenerates at a later stage. The male gametes are spherical and in *Lindenbergia indica* they are very small. The tube nucleus degenerates *in situ*.

DISCUSSION

During the development of the anthers some cells of the endothecium become biseriate and this feature has been recorded so far in only two species of *Russelia* (Pal and Pal, 1961) in this family. In *Mazus japonicus* the two nuclei in some tapetal cells fuse to form a tetraploid nucleus. In *Ilysanthes parviflora* (Raghavan and Srinivasan, 1941) and two species of *Striga* (Tiagi, 1956) fusion of nuclei in tapetal cells takes place at the four-nucleate stage.

Sometimes in the ovule of *Lindenbergia indica* a multiple archesporium is met with and this feature is recorded for other members of this family (Schmid, 1906; Milsaps, 1936; Srinivasan, 1940; Krishna Iyengar, 1942; Berg, 1954).

The development of the female gametophyte follows the Polygonum type (Maheshwari, 1950). In some embryo sacs of *Mazus japonicus* egg-like synergids were found as in *Russelia* (Pal and Pal, 1961). Though the antipodals are usually ephemeral in this family, they are found to be persistent in some taxa (Balicka-Iwanowska, 1899; Schmid, 1906; Glisic, 1933; Krishna Iyengar, 1937, 1942; Safeeulla and Govindu, 1950; Yamazaki, 1953).

The occurrence of a hypostase is not very infrequent in Scrophulariaceae and in the present investigation it is seen in *Lindenbergia indica*. The nature and the extension of the tissue and its time of differentiation are very variable (Balicka-Iwanowska, 1899; Schertz, 1919; Glisic, 1933; Milsaps, 1936; Krishna Iyengar, 1939; Guilford and Fisk, 1952; Berg, 1954; Yamazaki, 1953, 1954, 1957a, b). According to van Tieghem (1901), the hypostase

tissue acts as a barrier for the further growth of the embryo sac towards the chalazal end. Goebel (1933) believes that it is related to water economy of the embryo sac, since it lies directly above the end of the vascular supply of the ovule. In *Lindenbergia indica* the hypostase, to start with, may serve a nutritive role by supplying food materials to the growing embryo sac. It may also serve as a barrier for the growth of embryo sac at chalazal end because of its thick-walled nature. And probably it has a conducting function also because of its radially elongated cells connecting the chalazal region of the embryo sac with the end of the vascular supply of the ovule.

SUMMARY

In the present investigation, the organogeny of the flower and the development of the gametophytes in *Lindenbergia indica* (Linn.) Kuntze and *Mazus japonicus* (Thunb.) Kuntze are described.

The floral organs arise in the order: sepals, stamens and petals, and carpels. Some interesting behaviour of the endothelial and tapetal cells have been discussed. Microsporogenesis and development of the male gametophyte are normal. The pollen grains are tricolporate and two-nucleate.

In the ovule of *L. indica* sometimes a multiple archesporium is met with. Megaspore-tetrads in *M. japonicus* are at times T-shaped. Development of the embryo sac follows the Polygonum type. Double fertilization has been observed.

Integumentary tapetal jacket in the ovule develops in both species studied. In *L. indica* a hypostase is organized.

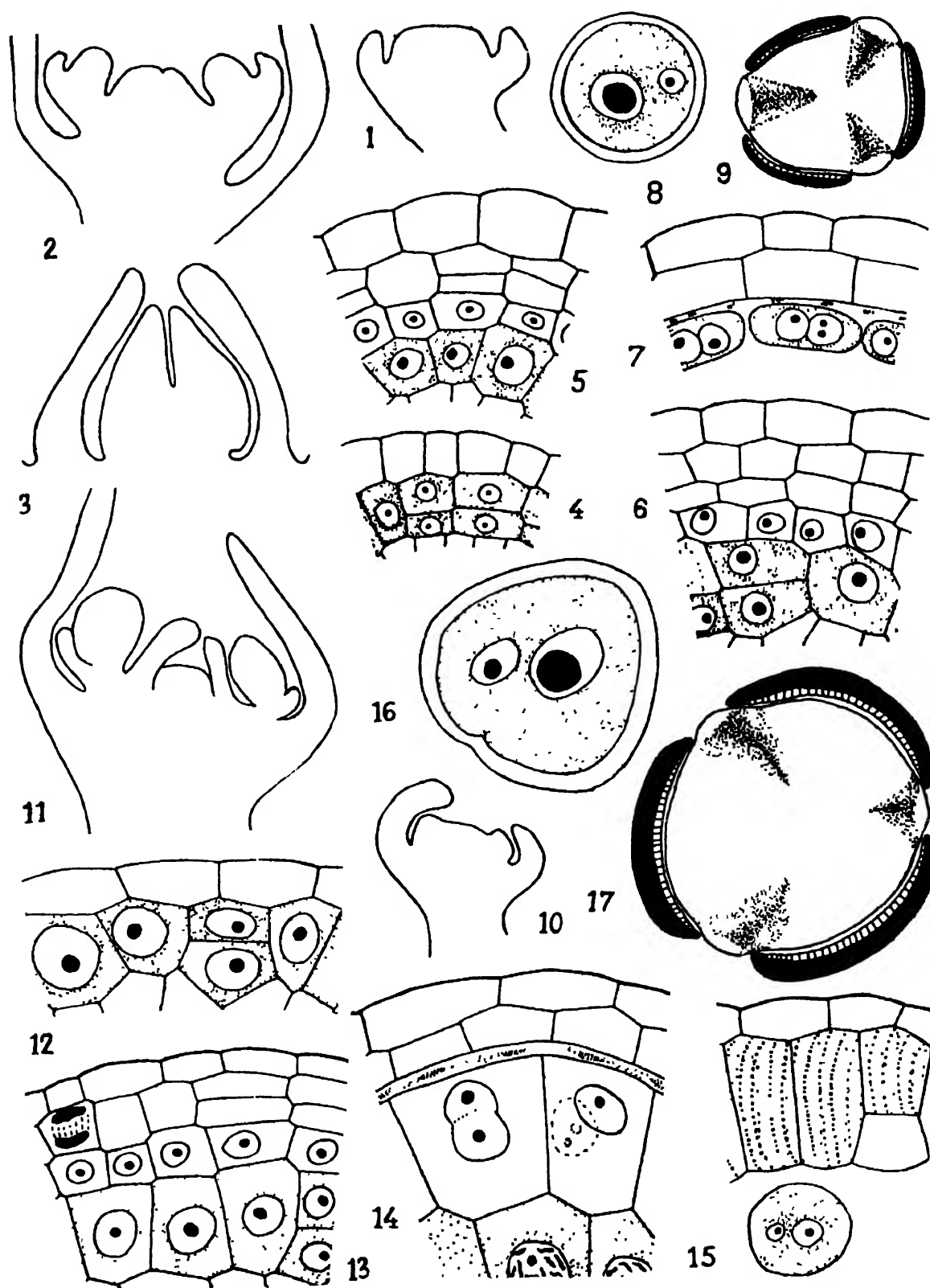
In conclusion, I express my deep sense of gratitude to Dr. I. Banerjee, D.Sc., F.N.I., F.A.Sc., for his kind interest and constant encouragement in this work. I am also grateful to Dr. S. K. Mukherjee of Botanical Survey of India for his kind help in consulting the Herbarium at Indian Botanical Garden, Sibpore, Howrah.

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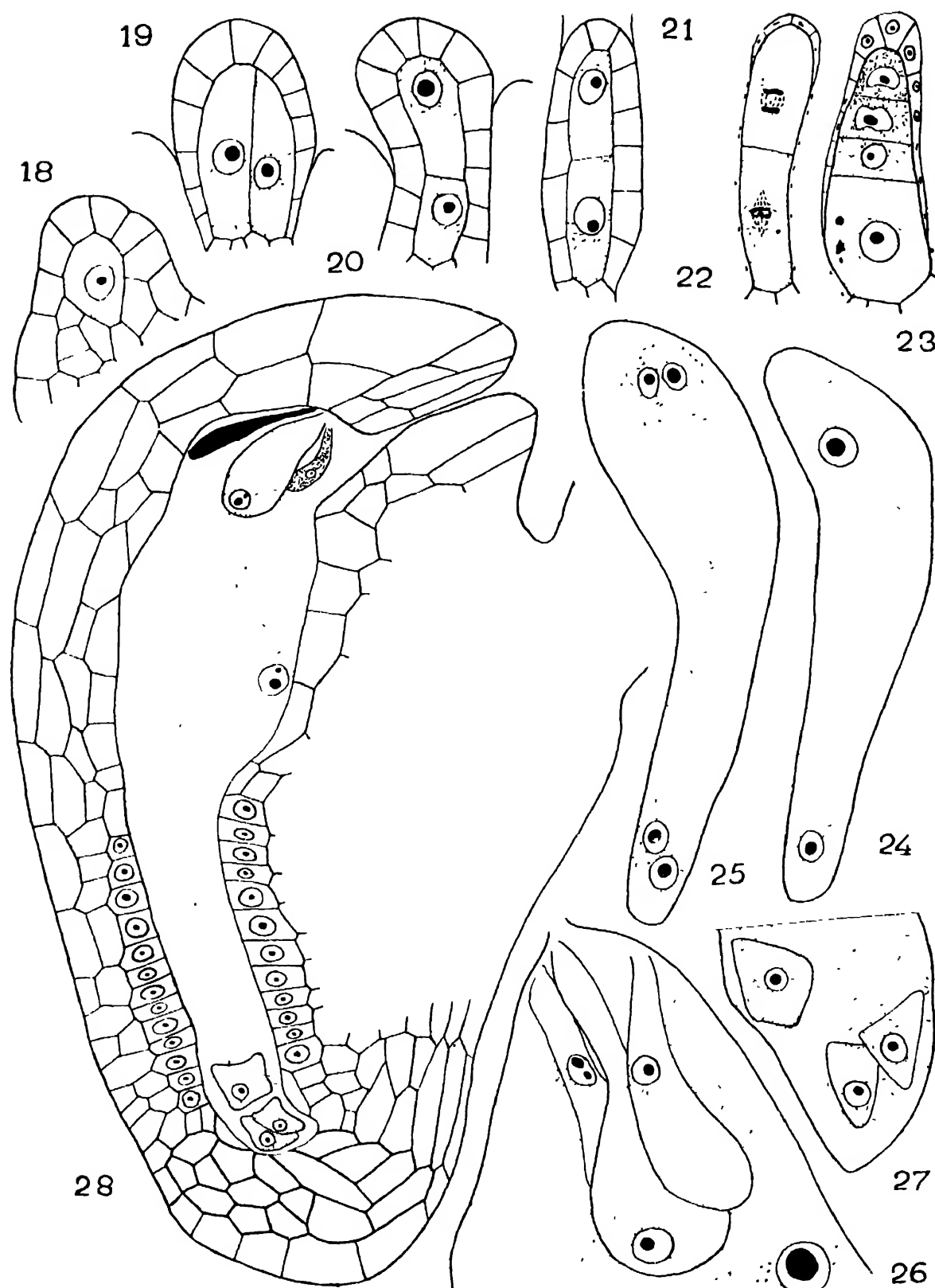
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Figs. 1-9. *L. indica*: Figs. 1-3. Stages in development of floral organs. Figs. 4-7. Developmental stages of anther. Fig. 8. Two-nucleate pollen grain. Fig. 9. Mature pollen grain.

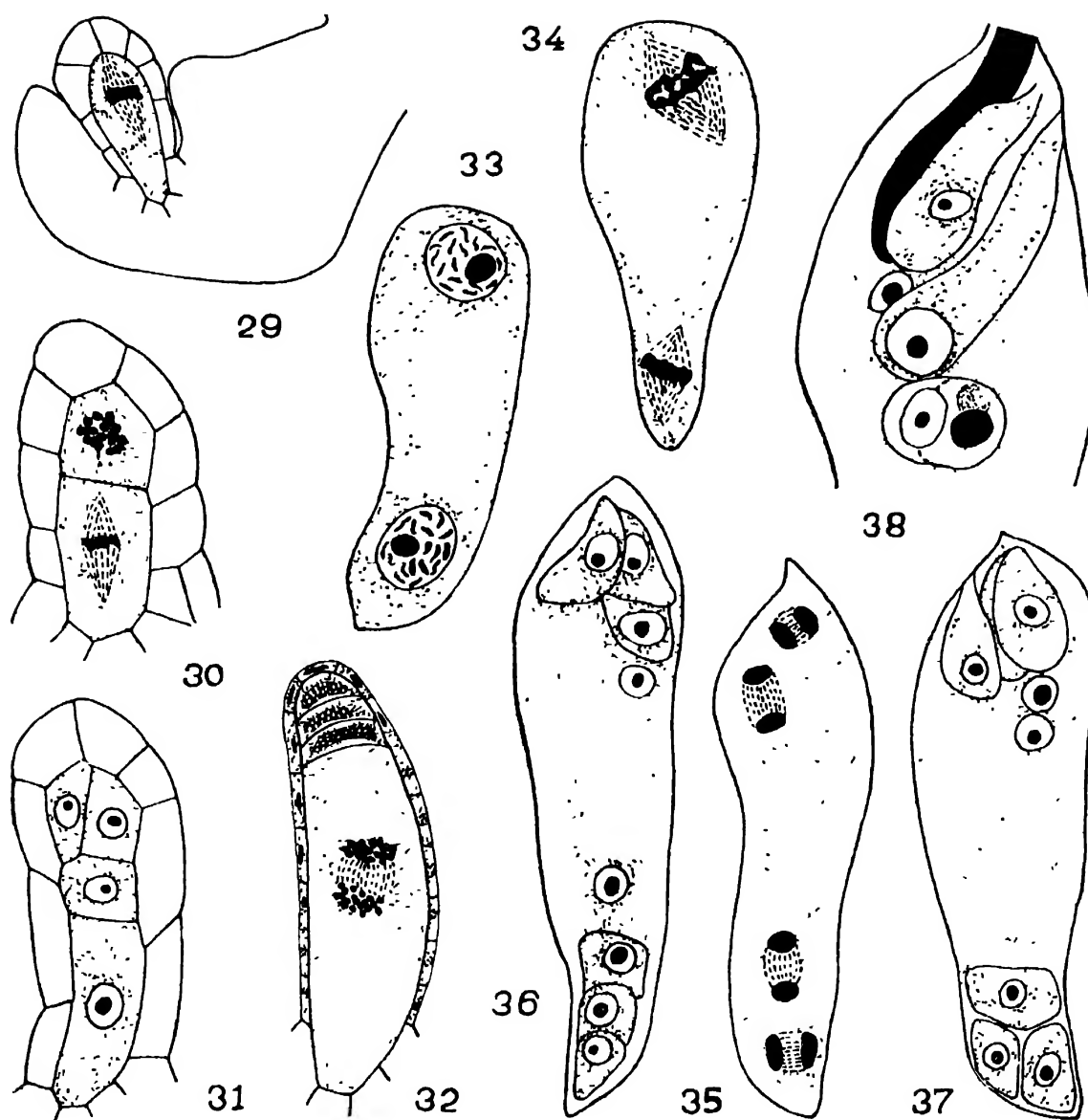
Figs. 10-17. *M. japonicus*: Figs. 10, 11. Developmental stages of flower. Figs. 12-15. Stages in development of anther. Fig. 16. Two-nucleate young pollen grain. Fig. 17. Mature pollen grain.

Figs. 1-3, 10, 11, $\times 100$; 4-7, 12-14, $\times 900$; 15, $\times 580$; 8, 9, 16, 17, $\times 1,460$.



FIGS. 18-28. *L. indica*. Fig. 18. Archesporium in the ovule. Figs. 19-20. Multiple archesporium juxtaposed and superposed. Figs. 21-23. Megasporogenesis. Figs. 24-25. Two- and four-nucleate embryo sacs. Figs. 26-27. Micropylar and chalazal ends of the mature embryo sac showing the egg-apparatus, secondary nucleus and antipodal cells. Fig. 28. L.S. of ovule after fertilization showing persistent antipodals and the hypostase.

FIGS. 18-25, 27. $\times 900$; 26, $\times 1,480$; 28, $\times 700$.



FIGS. 29-38. *M. japonicus*. Fig. 29. L.S. of young ovule with dividing megaspore mother cell. Figs. 30-31. T-shaped tetrad formation. Figs. 32-36. Stages in the development of embryo sac. Fig. 37. Mature embryo sac. Fig. 38. Double fertilization.

FIGS. 29, $\times 700$; 30-37, $\times 900$; 38, $\times 950$.

REVIEWS OF BOOKS

THE HEVAJRA TANTRA: A CRITICAL STUDY—Part I, Introduction and Translation; Part II, Sanskrit and Tibetan Texts—by D. L. Snellgrove, Lecturer in Tibetan, School of Oriental and African Studies, London. Published by Oxford University Press. Price (in U.K. only) £5 5s. net (two volumes).

Tantricism, whether Hindu or Buddhist, is not to be found clearly and completely expounded in any of the extant texts; the views are to be culled, correlated and systematized before one can expect to have an idea as to what the practices actually are and what the import of the doctrines associated with a mass of apparently heterogeneous practices may be. A critical study of at least the important Tantric texts is, therefore, a prerequisite for a thorough study of Tantricism. So far as Buddhist Tantricism is concerned, the Oriental Research Institute of Baroda has indeed done a great service by bringing out in the Gaekwad Oriental Series a number of important texts, some of which have been critically edited. Of the Tantric Buddhist texts the *Hevajra Tantra* seems to occupy a very important position. It is the most frequently and aptly quoted text in the Sanskrit commentaries available on the Tantric Buddhist songs in old Bengali and the Dohas in Apabhramśa. Mr. D. L. Snellgrove has indeed earned the respect and gratitude of all students of Buddhism—particularly of all students interested in the transformation and ramifications of Buddhism in different countries in later times—by bringing out a critical study of this important text.

Tantric Buddhism is not now an unbeaten tract; yet when Mr. Snellgrove warns us 'to beware of the general manner of discussion, which is far too naïve in its approach' and when he charges 'that we are attempting to generalize on a vast subject, in which there is no lack of material, by short-cutting the longer task of examining these texts in detail and in their own context', the present reviewer himself frankly pleads guilty to the charge. After a perusal of the two volumes under review we feel tempted to say that it would have perhaps been easier for Mr. Snellgrove to attempt a general discussion on the doctrines and practices of the Tantric Buddhists than set his hands to bring out a critical study of the important text of the *Hevajra Tantra* with an English translation, notes and an illuminating introduction. The author has established the reading of the text on the basis of three extant manuscripts, comparing it with the Tibetan version of the whole text. In the second volume of the book the Tibetan version has been given side by side with the Sanskrit version, so that scholars acquainted with both the languages may compare the two versions wherever necessary for a better understanding of the obscure doctrines and practices. The publication of the well-known commentary on the *Hevajra Tantra* entitled '*Yoga-ratna-mālā*' (or *Hevajra-pañjikā*) along with the text has made the publication immensely richer. The care, intelligence and diligence with which the author has discharged his duties in establishing the correct reading of the text (as far as practicable) is almost exemplary. But no less admirable has been his bold attempt at and great success in translating the complete text in English, adding notes wherever necessary.

In the introduction Mr. Snellgrove has attempted a brief survey of the developments in Tantric Buddhism and has also discussed the contents

of the text of the *Hevajra Tantra*. A good understanding of the text has enabled the writer to discuss with confidence some of the knotty problems. One of the main problems, however, remains still unsolved, and that is, how much of the text is to be understood in its obvious sense, and how much in a figurative or symbolic sense. That the whole of it is not to be taken in the obvious sense, nor again the whole should be interpreted in the figurative or symbolic sense—there is no disagreement, we think, among the scholars; but the anomaly arises because of the scope for having it interpreted in either of the ways. The fact that 'the leaders of this new period persist in regarding it in a figurative sense' (page 17 of the introduction) clearly indicates their apathy towards some of the unconventional practices, which were nevertheless facts and factors in the spiritual endeavour of the Tantrics.

After a careful perusal of the two volumes prepared by Mr. Snellgrove we have reasons to be convinced that he possesses not only a negatively unprejudiced but a positively sympathetic attitude which enables one to understand a foreign religion and culture in its true perspective even from the academic point of view; coupled with it is the fact of the amount of intelligent labour which the author has spared in preparing these two volumes, for both of which he deserves unreserved congratulation.

SHASHI BHUSAN DASGUPTA

JÑĀNALAKṢAṆĀ-VICĀRA-RAHASYAM OF SHRI HARIRAMA TARKAVAGISA.
Edited with a new Commentary by Pandit Ananta Kumar Nyaya-Tarkatirtha.

The treatise under review is the third member of a distinguished series of publications undertaken by the Research Department of the Sanskrit College, Calcutta. The author, Shri Harirama Tarkavagisa, was perhaps the teacher of his more celebrated pupil, Sri Gadadhara Bhattacharya, that imposing giant of the Neological School of Bengal. Our author, Pandit Tarkatirtha, does not fail to leave in his work the unmistakable impress of an abundant genius.

It is well known to the students of Indian philosophy that the Naiyāyikas, in order to explain some peculiar epistemic phenomena, have propounded the famous trio of extraordinary perceptions, viz. Sāmānya Lakṣaṇā, Jñānalakṣaṇā and Yogaja. The Sāmānyalakṣaṇā has received a good deal of attention because it has served the Naiyāyikas as their main plank for taking the inductive leap towards a universal proposition which is the major premiss of a syllogistic reasoning. The Yogaja has been left to reign in an obscure domain, since it is a type of mystic perception which only those who are initiated in esoteric knowledge have the hope to enjoy. Jñānalakṣaṇā, like Sāmānyapratyāsatti, is a matter of mundane interest. Hence the term 'alaukika' which the Naiyāyikas have unfortunately chosen to cover the trio is not synonymous with esoteric cognition, though Yogaja, or mystic perception, is a member of the triad.

Perception is undoubtedly the result of sense-contact. But for the Naiyāyikas the term sense-contact means much more than what common sense takes it to be. To suit their purpose they have stretched the term like a rubber ribbon to include in its fold the six types of Sannikarṣa which they call 'laukika' and in which the corresponding sense-organ directly or indirectly is supposed to contact the appropriate object. But still there

is a host of epistemic situations, falling somehow within the range of perception, which even this sixfold contact theory is felt insufficient to explain. Jñānalakṣaṇā and Sāmānyalakṣaṇā are two exoteric instruments which the Naiyāyikas have invented to explain these common but peculiar cognitive phenomena, which, however, they feel, cannot be explained in a common manner.

The stock-example of Jñānalakṣaṇā deals with the predicate of such a perceptual proposition as 'It is a fragrant piece of sandalwood', in which fragrance is felt to be a visual object along with the sandalwood. Obviously it is an anomalous situation in which one is supposed to see the fragrance of a thing. The queer nature of this 'sight' demands an explanation. Now, every percept is a presentation which normally requires an object to be presented before the appropriate sense-organ. So when a percept deviates from the object, or comes to be even in absence of an object, there must be a way out in which even the absent object should be somehow presented to the sense. And hence it is supposed in this case that the vivid remembrance of a past-smelt fragrance, serving as the point of an abnormal contact, presents the unpresent fragrance to the otherwise inappropriate organ of vision. For the Naiyāyikas it is not just a poetic way of speaking about a queer shape of event, since they think that even what is absent must be somehow contacted by the sense-organ that normally cannot grasp it, because otherwise the visual percept of a fragrant sandalwood cannot be accounted for. This extraordinary theory of extraordinary perception (Jñānalakṣaṇā in this case) has been extended to cover the cases of illusion, recognition, introspection and the perception of negation. Every such perception is a blend of the normal and the abnormal. With all the analytical skill which a profound Naiyāyika of the New School should possess, this theory of Jñānalakṣaṇā has been unrolled in the pages of the book under review.

Our review would not be complete without expressing a note of admiration for the learned commentator, Sri Ananta Kumar Nyaya-Tarkatirtha, who has supplied a valuable modern commentary to the original treatise of Sri Harirama. The commentator, though a reputed Naiyāyika of the present days, has refused to be hidebound by the formulae of the school to which he belongs. Thus he has boldly rejected Jñānalakṣaṇā in cases of introspection and perception of negation and the independent arguments he has adduced in favour of his viewpoint deserve careful consideration. One could have rejected Jñānalakṣaṇā in these two cases with a completely different set of arguments, but that is of course a different matter altogether. Our learned commentator also seems to have rejected a well-known observation of Raghunatha Siromani to the effect that in case of seeing a fragrant piece of sandalwood Jñānalakṣaṇā should be admitted for explaining at least the perception of the universal fragrance (Saurabhatva), if not that of a particular fragrance (Saurabha). Our commentator has subscribed to the older theory that Jñānalakṣaṇā is necessary here for explaining the perception of Saurabha itself. There are many other points of intelligent interest for which the commentator may be congratulated. We are sorry that he has stopped half-way. If he had advanced further with his critical acumen, we hope, he might have altogether dispensed with Jñānalakṣaṇā. We congratulate the commentator for his illuminating commentary and refreshing freedom of thought.

ASHUTOSH BHATTACHARYA SASTRI

A BIBLIOGRAPHY OF INDOLOGY, VOL. I—Indian Anthropology. Published by the Librarian, National Library, Calcutta, 1960, 290 pages.

This latest bibliography on Indian Anthropology, although preceded by a more exhaustive one by Elizabeth von Fürer-Haimendorf, viz. 'An Anthropological Bibliography of South-East Asia', published in 1958, is a welcome addition to the reference books on Indian Anthropology and Sociology.

The presentation begins with a regional approach, covering the literature on the eight major natural regions of India and also the Andaman and Nicobar Islands. This is followed by special references on the following topics: General, basic data, history-cum-culture, language, arts (fine arts, useful arts, literature), lore and learning, religion, social stratification, social organization, women and religious communities and other groups. It will be clear from the above list that the emphasis of this volume is primarily on social and cultural anthropology, while publications on physical anthropology have not been adequately covered.

The volume has been provided with very useful author and subject indices.

NIRMAL KUMAR BOSE

A SURVEY OF INDIAN SCULPTURE. Double crown, pages 1-208, plates I-XL. By S. K. Saraswati, M.A. Published by Firma K. L. Mukhopadhyay, Calcutta, 1957. Price: Rs.20 (De Luxe Edition: Rs.22.50; Foreign: 35 shillings).

Sculptures of the ancient and mediaeval period constitute a fascinating branch of study in art and archaeology of India. They have been studied by generations of scholars and art connoisseurs of India and other countries from various points of view, and a substantial literature in different languages has grown up round the subject. The ancient sculptors of India attempted to express in plastic form the nature and general trends of the thought and culture of their land. The major portion of their artistic activities was also made to serve the religious needs of their people. The sculptures fashioned by the chisels of the *śilpīns* of different periods could also count as so many landmarks in the artistic and cultural achievements of the country. The numerous studies centering round them have brought out from time to time their various aspects for the proper understanding and appreciation by all interested in Indian art and culture.

Sri S. K. Saraswati's monograph published in 1957 is a substantial addition to the already existing stock of similar studies. He is specially equipped for such a work, because of his long, continuous and discriminating researches in this field. His already published works on the subject contain sure evidence about his clarity of thought and expression, and they have engaged the serious attention of scholars.

The subject is a vast one, and the author has confined himself mostly to the task of setting forth 'the various trends and tendencies that went to constitute Indian plastic tradition' from the earliest times to the end of the Gupta period. He has not attempted a detailed study of the history of mediaeval Indian sculpture, for that would have enormously enhanced the bulk of his present volume. But in section VII of its sixth chapter as well as in the epilogue (Ch. VII), he has discussed the general tenor of mediaeval sculpture in its principal expressions, and has broadly delineated such topics as the transition from the classical to mediaeval sculpture, the

development of hieratic trait in it, the regional character of the art movements of the mediaeval period, and the growth of various provincial styles spread over different parts of India. It should be noted, however, that he has expressed his intention in the preface to write a companion volume in which the details of the history of mediaeval Indian sculpture will be elaborately dealt with.

Sri Saraswati's book consists mainly of six chapters of unequal length dealing with such topics as (1) the beginnings of plastic art (Ch. I), (2) Mauryan and post-Mauryan sculptures (Chs. II and III), (3) sculptures of the Śaka, Kushāṇa and the Āndhra periods (Ch. IV), (4) terracotta figures (Ch. V), and lastly (5) the acme of the classical trend in Gupta sculpture and the post-Gupta sculptural trends in various parts of India (Ch. VI). This analysis shows that he has chalked out the programme of his work in a well-thought-out manner, and the contents of each section of it show that he has a full knowledge about the latest researches on the subject. There is as usual a select bibliography, and in the end of each chapter are placed necessary lists of references in place of footnotes appended to each page. A useful index is included, and this is followed by as many as forty plates containing good reproductions of numerous sculptures (their exact number is 183), well chosen representatives of the Indian plastic art of different periods.

Sri Saraswati begins with a special emphasis on the origin and early growth of plastic concept in India, and throughout his work he never loses this historical perspective. He does not concern himself with the philosophic or iconographic aspects of Indian sculpture, but traces its phased development from the early Indus Valley period to the age of the Guptas. His attempts to bring out the essential traits of the sculpture groups of each successive period are praiseworthy, and his observations on them are precise, easily intelligible and mostly justifiable. Thus, his remark on the contrast in plastic forms manifest in the terracotta figurines of Harappa on the one hand and its few stone and bronze sculptures on the other is suggestive. This palpable difference might have been 'due to class distinctions which appear to have emerged as a result of the predominant commercial economy that provided the mainstay of this civilization' (pp. 8-9). The big hiatus separating the prehistoric phase of Indian art and its earliest historic phase has been noted by him. But he has rightly observed that this does not mean the non-existence of plastic art during this intervening period, and the plastic forms were evidently being created at that time in such easily perishable materials as wood, clay, ivory, etc. But the mystery still remains unsolved how stone of huge dimensions could be so skilfully handled by the artists of the Maurya-Śuṅga period, when stone as a medium of plastic expression was comparatively new in India. There is much to be said in favour of his support of the view held by a group of scholars that the use of the more permanent medium of stone for this purpose was due to foreign inspiration. That the indigenous sculptors of India originally were more used to handling wood for their art creations is proved by the tectonic character of many of the stone sculptures of the historic period. They might have shifted, however, to the use of a new material due to foreign contact, but in many cases they did not relinquish their own tradition and follow the technique of the alien art forms as the Rampurwa bull and the massive Yaksha figures of the Maurya-Śuṅga period prove.

The end of the Maurya period saw the beginnings of the classical movement which gained its apogee during the Guptas. Sri Saraswati has critically dealt with the special traits of each successive group of plastic forms created within this fairly long period of a little less than a millennium, and

never failed to take note of the gradual stages of progress and development. His appraisal of the Gupta art creations, specially of the human figure playing the role of the divine image and serving as the pivot of Gupta sculpture, is critical and competent. It has become a fashion with a very small number of the so-called art critics of modern times to decry the quality and excellence of the Gupta art forms—especially of the man-god figures of the Gupta age. But there is no doubt that the human body 'composed of parts in terms of similitudes drawn from various elements of nature' resulted in 'an idealized form illumined by a supreme sense of organic and rhythmic beauty' (p. 126).

It will not be possible to dwell upon the many good features of Sri Saraswati's book in the space of a short review. A critical and discriminating reader will find in it much to learn and appreciate, though he may not agree with each and every finding of the author. But these cases of disagreement are very few and far between, for the author is very cautious and circumspect in the majority of his conclusions, and has not departed from the usually accepted methods of art criticism. The printing, get-up and the plates are really good, and typographical errors are very few.

J. N. BANERJEA

8-6-61

INDIA THROUGH CHINESE EYES, Sir William Meyer Endowment Lectures, 1952-53, pp. i-x, 1-199. By Surendranath Sen. Published by University of Madras in 1956. Price Rs. 4.

Dr. Surendra Nath Sen chose his topic for the 'Sir William Meyer Endowment Lectures' delivered by him in the Madras University at a time (1952-53) when relations between India and China were friendly and cordial. They have changed for the worse in recent years for reasons well known to all. But whatever may be the present set-up of political conditions of these ancient countries, systematic account of a general character about the socio-religious and cultural contacts between them in the past has its special value. Highly civilized China, which could produce a Lao-tze and a Confucius, and where Tao-ism had developed, did find it profitable to adopt officially one of the most important religions of the world, which had its origin in India. Two Buddhist monks from India, Kaśyapa Mātāṅga and Dharmarakṣa, took the gospel of the Buddha to the Chinese Court in A.D. 67, and there is reason to believe that there were earlier contacts mostly of a mercantile character between the two countries. From the early centuries of the Christian era, however, began the flow of Chinese savants and religious men towards the West, who went on pilgrimage to the Buddhist holy shrines in India, the land of the Buddha (*Āśoka*), and collected and carried home numerous Buddhist manuscripts for study and translation. This traffic was not of a one-way character, for as I-tsing says, 'Indian Bhikshus came to China one after another, and the Chinese priests of the time being, crowded together before them and received instruction from them'. Kumārajīva and Paramārtha, two of the most prominent among the former, worked in China in the first part of the fifth century A.D. and the middle of the next century respectively, and helped the Chinese monks by translating numerous Sanskrit Buddhist works into their language.

It is well and good that such an eminent scholar and historian as Dr. Sen should select the accounts of India given by generations of Chinese writers and pilgrims to this country for the subject of his extension

lectures. Prof. Liang-chi-chao says that 'no less than one hundred and sixty-nine pilgrims set out for India during the six hundred years between the third and the eighth centuries of the Christian era, not all of whom could reach their goal and many of whom are not known by name. General readers know something about only a few of them like Fa-hian, Hiuen-tsang and I-tsing. Dr. Sen has not only taken the materials for his lectures principally from the travel accounts of these three, but also from the writings of a few others, not all of whom came to India. His first and second lectures deal with the general account about the pilgrims; the records about India and her people left by them form the subject-matter of his third lecture, while the Chinese travellers' tales about the scholars, poets and philosophers of India, and the Indian system of learning and education are dealt with in his fourth and fifth lectures. In the sixth and the last lecture he has collected relevant information about the numerous interesting observations made by such notable pilgrims as Fa-hian, Hiuen-tsang and I-tsing about the kings and chronology of India. In the three appendices to the printed lectures, the learned lecturer has made some remarks about the Chinese encyclopaedist Ma-twan-lin, some Chinese pilgrims, and the attempt of an heretic on Harsha's life. There is a useful index at the end. This analysis shows that Dr. Sen has left untouched very little that is of interest from the Indian point of view about our country as seen by the Chinese travellers of earlier times.

Dr. Sen is not a Sinologist, neither does he claim to know the Chinese language. He has had thus to depend on authoritative translations of the Chinese records for his lectures; but he has made very intelligent use of them and arranged his matter in a very skilful and efficient manner. His compilation, he says in the preface, 'has no pretension to learning'. But the work that has been produced by him is good and interesting to read, for it has a marked literary grace so much evident in his many other scholarly publications. Moreover it contains in one place a lot of information about India as seen through Chinese eyes which would be of immense help not only to the students of ancient Indian history and culture but also to other readers interested in it. There are a few inaccuracies in the use of diacritical marks and several misprints which are minor errors, and for which the author cannot be held responsible.

J. N. BANERJEA

21-6-61

STUDIES IN THE UPAPURĀṆAS, Vol. I (Saura and Vaiṣṇava Upapurāṇas), Calcutta Sanskrit College Research Series, No. II, 1958. Royal octavo, pp. i-xii, 1-398. By R. C. Hazra, M.A., Ph.D., D.Litt. Published by the Principal, Sanskrit College. Price Indian Rs.25; Foreign 42 shillings.

The major and the minor Purāṇas constitute a substantial section of the vast bulk of Sanskrit literature, and render an invaluable help for the reconstruction of the social, religious and cultural history of ancient and mediaeval India. Some of them also throw a fitful light on particular sections of the political history of ancient India, though evidence of this nature gleaned from them cannot stand comparison with similar information derived from some other literary and archaeological sources. The main difficulty about the Purāṇas is that one can never be sure about their respective dates, for, as in the case of the authors of the epics, the numerous writers of this branch of Sanskrit literature had a natural propensity to make copious additions to them from time to time. This has no

doubt decreased their value as dependable source for the reconstruction of the political history of ancient India, but a judicious and critical use of social, religious and cultural materials scattered throughout them is of immense value for the students of Indology.

Dr. R. C. Hazra by his very capable studies in the Purāṇic records of Hindu rites and customs, carried out by him more than two decades ago while he was at Dacca, retrieved to a great extent the stigma attached to them as source books of ancient Indian history. Of the few scholars and Indologists who made serious studies of the Purāṇas before him, the name of F. E. Pargiter stands foremost. But Pargiter did not study them so much as the containers of social, religious and cultural data, but used them for the reconstruction of the ancient Indian historical tradition. Dr. Hazra refrained from such an approach in his Purāṇic researches and confined himself at first to the study of the Mahāpurāṇas and the light they and some of the minor Purāṇas throw on the chronological development of the Hindu rites and customs. In the present book he has focused his attention to a section of the Upapurāṇas, in order to prove that they are 'rich as much in number as in content, that some of them are much earlier than many of the so-called Mahāpurāṇas, and that, like the extant Mahāpurāṇas, they are of capital importance not only for the study of the social and religious institutions of the Hindus from the pre-Gupta period downward, but also for varied information of literary, historical, geographical and cultural interest'.

Dr. Hazra has rightly pointed out that though the traditional lists of the so-called secondary Purāṇas as found in the *Kūrma Purāṇa* and similar other texts usually limit their number to eighteen, there were in reality many such works, some of which are now lost. In fact, the bulk of the Upapurāṇa literature is a vast one and this has forced him to confine his researches in the first volume of his projected course of studies to the Saura and Vaiṣṇava Upapurāṇas only. In the first chapter of the present book, however, after giving his readers an idea about the extensive character of this branch of the Purāṇic texts, he adduces sound reasons for concluding that the formation of the group of eighteen such works may be roughly placed between A.D. 650 and 800. But this does not preclude, as he says, the probability of tracing the beginnings of at least some older ones among them to the Gupta period. Another point which he has emphasized here is that though the Nibandhakāras and other writers of mediaeval India describe them as secondary works based on the Purāṇas (the *Matsya Purāṇa* actually calls them as mere sub-sections or *upabhedas* of the Mahāpurāṇas), in a large number of cases the Upapurāṇas are not inclined to class themselves as such. This disagreement between the tradition recorded in a certain section of Brāhmanical literature and the statement of a few of the principal Upapurāṇas has been explained by the results of his investigations into the origin of the extant Purāṇas and Upapurāṇas (pp. 19-24). The prefix *upa* in the word should signify that such texts as a class were composed after the major Purāṇas by a section of the Smārta adherents to various Brāhmanical religious systems which had grown to importance in the first few centuries of the Christian era. Their chronological position does not necessarily mean that they were of lesser importance. In a way these Purāṇas better serve the purpose of scholars and Indologists, for they have been much less worked upon and interpolated by the later redactors. Even when they were subjected to modifications and interpolations, these were usually done by persons belonging to the sects whose distinctive stamps the respective Upapurāṇas bore. These additions, again, 'are to be valued as the records of changes undergone

in different ages by the respective sects to which these works originally belonged' (p. 27).

In the second, third and fourth chapters of his book, Dr. Hazra has made an analytical study of the Saura Upapurāṇas, the major Vaiṣṇava Upapurāṇas like the *Viṣṇudharma*, *Viṣṇudharmottara* and the *Narasimha Purāṇas*, and the minor Vaiṣṇava ones like the *Kriyāyogasāra*, *Ādi*, *Kalki*, *Puruṣottama*, and the *Bṛhannāradiya* Purāṇas. Though *Sāmba Purāṇa* is the main Saura Upapurāṇa analysed by him in Chapter II, he has not failed there to dwell upon its interrelation with the Saura sections of such major Purāṇas as the *Varāha*, *Bhaviṣya* and the *Skanda*, and drawing interesting conclusions from this study. He has adduced good reasons for dating the major part of this Saura Upapurāṇa some time between A.D. 500 and 800, and Farquhar's finding about its date was also very similar to this view (according to the latter the present *Sāmba Purāṇa* was written between A.D. 550 and 900). But the text came to be added to in subsequent periods, and Dr. Hazra has suggested likely dates for the respective additions. The three Vaiṣṇava Upapurāṇas, which form the subject-matter of his analytical study in the third chapter, were being held in high esteem by the learned Brahmins as authoritative works of Dharma. His analysis of these texts, delineating the particular aspects of the Vaiṣṇava religious system, is critical and competent, and it deserves close study by all students of one of the major creeds of India. The other Vaiṣṇava Upapurāṇas, falling under the minor group, have been critically studied by the author in Chapter IV, and he has rightly suggested that many of them were compiled in Eastern India (mostly in Bengal), unlike the three major ones noted above, which were composed mostly in the western part of Northern India. He has given good reasons for dating the period of compilation of some of them between the beginning of the tenth and that of the thirteenth century A.D., though two among them, the *Bṛhannāradiya* and the *Kalki*, are given much earlier and later dates respectively (about the last quarter of the seventh and the beginning of the eighteenth century A.D.).

In the fifth and last chapter of his book he has collected relevant information about three extinct Saura and as many as thirteen Vaiṣṇava Upapurāṇas. He has delved deep to some extent in Purāṇas and other Brāhmanical literature of a comparatively late date for recovering their names and throwing light on the nature of these lost works, and has even suggested the likely dates of their circulation in different parts of India. A few of the major Purāṇas also, like the *Brahma*, *Brahmavaivarta* and *Garuḍa* in their present forms, are spurious works of late date, their original forms being untraceable. The Upapurāṇa literature also sustained substantial loss of this kind and Dr. Hazra's efforts in retrieving some information about them are highly commendable.

The observations made above with regard to Dr. R. C. Hazra's present work fully prove that it is a painstaking, critical and competent piece of research. Students of Sanskrit literature and Brāhmanical religion in particular, and Indological scholars in general, will find it indispensable for their studies. I would specially recommend the methodology of critical research adopted by the author of this work to be followed by young aspirants for scholarship and recognition. It is not that Dr. Hazra's book is free from all blemishes, but its many good features far outweigh them which are mostly of a minor character.

J. N. BANERJEE

THE INDO-GREEKS, pages i-xvi, 1-201, plates I-VI, 3 maps. By A. K. Narain, M.A., Ph.D. (London). Published in 1957 by the Oxford University Press, London. Price Rs.26.

A connected history of the Bactrian Greek rule over some portions of Northern and North-Western India in the two centuries or so immediately preceding the Christian era and part of the century following it is very difficult to write. Of the source materials for doing this, coins issued by these alien rulers of ancient India are the major ones, the other sources being two Indian inscriptions in which the names of two of the Indo-Greek kings can be surely read, some notices about them in the works of several of the Greco-Roman writers, like Diodorus, Strabo, Arrian, Plutarch, Justin and others, and a little information of a general nature about them in a few Indian texts like the *Mahābhāṣya* of Patañjali and the *Yuga Purāṇa* section of the *Gārgī Samhitā*, etc. It was Alexander Cunningham, one of the pioneers in the study of Indian archaeology, who in his numerous essays on the 'coins of Alexander's successors in the East', published in the various issues of *Numismatic Chronicle* in the sixties and seventies of the nineteenth century, first attempted to reconstruct this history mainly on the basis of numismatic data. Of the many scholars and Indologists who took up this work after him in right earnest, prominence should be given to Alfred Von Sallet, Percy Gardner, Edward James Rapson, George Macdonald, Richard Bertram Whitehead and, lastly, William Woodthorpe Tarn. It is to be noted that no Indian scholar interested himself deeply in similar studies, though the present reviewer made some humble contributions of this nature, mostly inspired by the work of the European scholars named above.

Thus it was a good thing for Indian scholarship when a young member of the All-India Numismatic Society selected this subject for his advanced studies and research about a decade and a half ago, and made afterwards a first-hand study of the Bactro-Greek and Indo-Greek coins in the collection of the British Museum and in other private collections in England. The principal guide in Dr. A. K. Narain's numismatic studies was Dr. R. B. Whitehead, the most competent living authority on Indo-Greek coins, and Narain submitted the results of his studies on the history of the Indo-Greeks for the Ph.D. degree of the University of London in 1954. The present work is mainly based on his thesis which possessed high merit, and which was soon taken up by the Oxford University Press for publication.

Dr. A. K. Narain's work is divided into six chapters dealing with introductory matter, the rise and growth of Greco-Bactrian power, its extensions to the Paropamisadae and Gandhāra, the climax of Indo-Greek power, the decline of the Indo-Greeks and lastly their final downfall. The four appendices contain interesting discussions on such topics as the terms Yavana, Yona, Yonaka, etc., the identification of the Seres and Phryni tribes named by some Greco-Roman writers, the location of Menander's capital Sagala, and lastly his critical analysis and emendation of the relevant passages of the *Yuga Purāṇa*. There are also a useful chart, where an attempt is made to arrange the Indo-Greek kings genealogically and chronologically, a select bibliography, an index, six good plates showing a few select coins of some Bactrian and Indo-Greek kings, and the Bajaur relic casket inscription of the reign of Menander and the Besnagar pillar inscription of Heliodorus in which the Indo-Greek king Antialcidas is described as the king of Takṣaśilā. Three sketch maps in the end outline Bactria and the surrounding regions, Northern India and adjacent countries

in the period of Menander (mid-second century B.C.) and India and neighbouring countries, showing important routes used by the Yavanas, Śakas, Pahlavas and Yue-chih.

This analysis of the principal contents of the book fully show that Dr. Narain has competently planned out his task. A careful study of the individual chapters and the appendices leaves little doubt about his critical and scientific approach to the various problems discussed by him. The subject teems with many lacunae and data prone to be differently interpreted by different scholars; thus deductions made from them are generally of a tentative character, and they are ever likely to be challenged by other scholars. It must be said to the credit of the author that he has never been dogmatic in his findings which were made by him after a careful appraisal of the views on particular topics upheld by his predecessors in the field. It will only be possible in the space of this short review to point out a few such instances where he has done this. Thus his support of the view held by previous scholars about the existence of settlements of Greeks in the north-west of India long before Alexander is judicious and well-based (pp. 2 ff.). But at the same time he never hesitates to challenge the interpretation of such eminent historians as W. W. Tarn. He rightly criticizes the latter's view that 'in the history of India the episode of Greek rule has no meaning; it is really part of the history of Hellenism'. His opinion that Tarn's judgement is partial for he has over-emphasized the Hellenistic aspect is perfectly justified (p. 7). A few other comparatively loose statements of Tarn have been rightly criticized by our author. It may be enough to refer here to only one among them. Tarn, misquoting an observation of Rapson made by him in *Cambridge History of India*, Vol. I (p. 575), remarked that Strato I in conjunction with his grandson was the last Indo-Greek king to rule in Mathurā. But this remark has no foundation; Rapson did never say any such thing, and 'the coins supply no evidence of Indo-Greek rule in Mathurā, or any such interior region of the Madhyadeśa (p. 89). The *Yuga Purāṇa* or the *Mahābhāṣya* statements about the Yavana penetration of Mathurā, Pañchāla, Sāketa and Madhyamikā distinctly show that this constituted mere raid and no occupation. But Dr. Narain's suggestion that 'the evidence of the *Yuga Purāṇa*, Patañjali's *Mahābhāṣya* and Kālidāsa's *Mālavikāgnimitra* shows that there was only one invasion in which the Indo-Greeks participated' (p. 88) appears in a way to support Dr. Tarn's view about the unitary character of the Yavana raid into the Madhyadeśa in the middle of the second century B.C. (Tarn, *The Greeks in Bactria and India*, pp. 140, 155, 200), though Dr. Narain would never credit Euthydemus I's son Demetrius with this exploit.

The author, in course of his partial reconstruction of the history of the rise and expansion of the power of the Bactrian Greeks in Chapters II and III of his book, has challenged many findings of such previous scholars as Gardner, Macdonald, Rapson and others. Mention may be made here of a few such criticisms, e.g. Macdonald's interpretation of the numismatic data regarding the problem of two Diodotuses (pp. 14-18), Rapson's suggestion about the reign period of Euthydemus I extending up to c. 190 B.C. (pp. 21-22), the opinion of many of the aforesaid scholars about the conquest of the Kabul valley and Gandhāra by Euthydemus I's son Demetrius, etc. The reasons adduced by him for a few of these criticisms, though not fully convincing, have much in their favour. But his hypothesizing the existence of another Demetrius, whoever he may have been (p. 31), who issued the bilingual coins bearing this name, is problematic. Then he, following Macdonald, Tarn and others, sometimes obviates

difficulties about the conflicting nature of data about Demetrius and Eukratides by postulating more than one such ruler bearing the same name. Thus Justin's mention of one *Demetrius, king of the Indians*, a rival of the Bactrian king Eukratides, has been explained away by him with the observation that this Demetrius was a completely different person from the well-known son of Euthydemus I. This might or might not have been the actual fact. One can never be definitely sure about such conclusions drawn on the basis of mutually conflicting data. Tarn unjustifiably suggested that it was a son of the first Demetrius who was responsible for the callous murder of Eukratides. Dr. Narain refers to the existence of a second Eukratides, accepting the views of such scholars as Bayer, Rochette, Macdonald and Tarn. This view, however, was not unanimously accepted. Our author at the same time would not accept the possibility of their having been two Apollodotuses, a view upheld by several numismatists. Many of these hypotheses are undoubtedly of a conjectural character. Yet it must be admitted that Dr. Narain has evinced a great deal of skill and acumen in piling up selective and subtle arguments in support of his various conclusions, some of them being different from those accepted by others.

It will be impossible for the present reviewer to attempt even a tolerable inventory of the many interesting deductions made by the author regarding the various problems of his subject in the space of this short review. The third to the sixth chapters of his book teem with such conclusions, a good many of which bear clear sign of his intensity and originality of thinking. He marshals his data and arguments based on them with such consummate skill that even when one hesitates to accept some of his findings one cannot but be deeply impressed by the manner and earnestness of his reasoning. He possesses all the necessary equipment for the critical study of a difficult subject, and has acquitted himself with credit in the performance of this task. One other point which strikes the discriminating reader of this book is the author's clarity and correctness of expression.

J. N. BANERJEA

15-6-61

THE COINAGE OF THE GUPTA EMPIRE (CORPUS OF INDIAN COINS, Vol. IV), pages i-xvi, 1-390; plates I-XXVII. By Dr. A. S. Altekar, M.A., LL.B., D.Litt. Published by the Secretary, Numismatic Society of India, Banaras Hindu University, 1957. Price Rs.30 (for members, Rs.25); Foreign £3 3s. (for members, £2 10s.).

The Numismatic Society of India was feeling for a long time the need for bringing out a series of corpuses of Indian coins from the earliest times to the present day, dealing with their history and numismatic features. The Society under the guidance of Dr. A. S. Altekar, for many years its Chairman, planned a comprehensive programme for publishing more than ten such volumes, the composition of some of which was assigned to different Indian numismatists. Dr. Altekar, the originator of the scheme, was given the charge of volume IV in the series, which had for its subject-matter the coinage of the Gupta empire and its imitations. The performance of this task could not have been assigned to more competent hands, for Dr. Altekar was a distinguished scholar and numismatist, his contributions specially to this branch of ancient Indian coins being of outstanding importance. He took up the work in right earnest and made ready its first press copy as early as 1946. But the Bayana Hoard of Gupta gold coins

was discovered at that time, and he was entrusted with the task of classifying and cataloguing it. The hoard contained many new varieties of such coins, and this as well as other considerations compelled him to give this work top priority. The *Catalogue of the Gupta Gold Coins in the Bayana Hoard* was published by the end of 1954. The sending of the *Corpus*, Vol. IV, to the press was thus unavoidably delayed, and this could be done only in 1953 after the new finds in the Bayana hoard were incorporated into it. It could not be brought out earlier than 1957 on account of the various preoccupations of the author and several other reasons. In the meanwhile, the Bihar Government Rāshtra Bhāshā Parishad had brought out its Hindi version in 1954.

The main purpose of the projected corpuses, as has been happily put by Dr. Altekar in the preface to this volume, is 'to take a stock of the published works, utilize all the material in the different Museums in India and abroad, take note of the later discoveries of important coins and sum up our knowledge of the subject, correcting views no longer tenable and emphasizing new and important aspects disclosed by fresh discoveries and studies'. This has been fulfilled to a very great extent by its author who has set an example to the prospective writers of the other volumes in the series. Dr. Altekar has incorporated in it twelve chapters and as many as seven appendices the last of which consists of a select bibliography. The first two chapters deal with a brief outline of the history of the imperial Guptas and general introduction to the Gupta coinage respectively. Chapters III to XI give a type-wise account of the coins of Chandragupta I, Samudragupta, Kācha, Chandragupta II, Rāmagupta (due to the inadvertence of the press and the absence of the author from India the chapter on Rāmagupta's coins have been wrongly placed after that on the coins of Chandragupta II; the order should be inverted), gold coins of Kumāragupta I, his silver and copper coins, and the coins of Skandagupta and his successors. The last chapter deals with the symbols, metrology and palaeography of the coin legends, and the different recorded hoards of the Gupta coins. The first appendix contains a detailed account of the coins of several rulers in which the technicalities of the Gupta coinage were copied and nondescript ancient imitations of the Gupta gold coins. A fairly long list of addenda and corrigenda forms the subject-matter of Appendix II, and the remaining appendices contain the genealogical and chronological table of Gupta kings, index to types and motifs, general index, conversion table of inches and grains into centimetres and grammes and a select bibliography. Some printing and other errors in the book have been rectified in the errata placed at the end.

Systematic study of Gupta numismatics was first begun by Vincent Smith who published several big articles on the coinage and history of the Gupta period in the *Journal of the Royal Asiatic Society* (1889, 1893), *Journal of the Asiatic Society of Bengal* (1884, 1894) and *Indian Antiquary* (1902). The section IV of his *Catalogue of Coins in the Indian Museum*, Vol. I, published in 1906, contains some interesting details about the Gupta coins in the Indian Museum. The most outstanding worker on the coinage of the Guptas after Smith and before Altekar was J. Allan whose *Catalogue of the Coins of the Gupta Dynasties and of Śaśāṅka, King of Gauda* was published in 1914. Allan's book was far more comprehensive than the articles of Smith, for many more materials were at his disposal. It was not only the Gupta coins in the British Museum that were incorporated in his *Catalogue*, but many other similar coins in the collections of other important museums and private persons were described by him. Moreover, in the erudite and extensive introduction to it, Allan interpreted several groups of

Gupta coins in a way different from that of Vincent Smith. Two such instances only may be mentioned here: one is his interpretation of the Gupta gold coins bearing the effigies of Chandragupta I and his queen Kumāradēvī, and the other is his attribution of the gold coins bearing the name of Kācha. Both the groups were attributed by him to Samudragupta, while V. A. Smith assigned the first to Chandragupta I, the second being attributed by him to an unknown ruler of the Gupta lineage.

The reasons given by Allan for his views remained highly plausible ones till Altekar came to cut the ground under them by his well-chosen and forcible arguments in several of his major articles appearing in the volumes of the *Numismatic Supplement* (to *J.A.S.B.*). In fact these were in a way indicative of his major debut in the field of Gupta numismatics, and their substance was also incorporated by him in his principal works of this nature, the *Bayana Hoard Catalogue and Corpus, Vol. IV*. Altekar in criticizing Allan's views lent weight to the previous views of Smith and others. In doing so, however, he introduced many new and strong arguments.

Dr. Altekar's present work containing a full knowledge about the different varieties of Gupta coins and the imitations of some of them will not only be of great use to the advanced students of Gupta numismatics in particular, but it will also serve as an authoritative book of reference for Indologists in general. Until any further discoveries of such hoards of outstanding importance as the Bayana hoard are made, Dr. Altekar's work will remain a comprehensive and up-to-date inventory of Gupta coinage.

The author's description of the numerous types of such coins is full and accurate, and his restoration of some of the indifferently preserved legends on them is clever and interesting. Reference may be made here to only one such legend on the unique 'king-and-queen-on-couch' type gold coin of Chandragupta II. In Appendix No. II, pp. 345-46, he has justifiably restored it as '*Rathimatho'tirathapravarah Kshitau*' and interpreted it as '(King Chandragupta) who is pre-eminent (*pravarah*) on the earth among unrivalled *atirathas*, is the destroyer of chariot-warriors (*rathimathah*)'. But some of his suggestions, which he has himself described as of a tentative character, are not always acceptable. Thus his views on the problem of the attribution of the Kācha coins and the place of the issuer of them in the imperial Gupta genealogy as well as his attribution of the few tiny copper coins of Malwa bearing the indifferently preserved legend 'Rāmagupta' require critical and careful study before final acceptance. But it must be observed in all fairness to the author that he himself was not satisfied about his views, for he remarked, 'It has to be admitted that we are not yet able to solve the problem of the identity of Kācha of gold coins and of Rāmagupta of the copper coins' (p. 87). Dr. Altekar in this mature work from his pen has been more critical about some of his earlier theories. The twenty-seven plates in the book, though not bad, are not as sharp and distinct as they should have been in such an authoritative work.

The present reviewer does not intend here to bring into relief the many good features of the work of Dr. Altekar. He, however, expresses his deep sorrow at the sudden death of this fine scholar and numismatist a little less than two years ago (November, 1959). Had our author lived much longer, the study of Indian numismatics and Indology would have been further enriched. He was a dynamic worker, a capable organizer and a brilliant scholar.

J. N. BANERJEA

20-6-61

THE EXCAVATIONS AT KAUSĀMBĪ (1957-59). Double crown, pp. i-xx, 1-225, plates 1-55, figures 1-18. By G. R. Sharma, Head of the Department of Ancient History Culture and Archaeology, and Director, Kausāmbī Expedition, University of Allahabad. Published by the Department of Ancient History Culture and Archaeology, University of Allahabad, 1960. Price Rs.35.

It is just a century ago that Bayley suggested to Cunningham that the ancient city of Kausāmbī could be identified with the old village of Kosām about 37 miles south-south-west of Allahabad. Working upon this suggestion, Cunningham carried on his investigations and became sure that the extensive ruins near the present villages of 'Kosām Inām' and 'Kosām Khirāj' (rent-paying and rent-free Kosām) on the bank of the Yamunā, indicated the site of the capital of Vatsarāja Udayana, a contemporary of Buddha and a colourful personality. This well-reasoned conclusion of the great archaeologist, however, was not accepted by several other investigators headed by Vincent Smith who suggested different sites at different times, for these would, according to them, better fit in with the observations of Fa-hian and Hiuen-tsang about its exact location. But subsequent exploratory researches of the Indian Archaeological Department in the present century proved beyond doubt the correctness of the Bayley-Cunningham identification.

The Archaeological Department of India, however, did not undertake extensive excavations at the site, and it was a happy idea of Sir Mortimer Wheeler, a previous Director-General of Archaeology, to allow the University of Allahabad to conduct them at Kausāmbī. Sri G. R. Sharma, a young teacher in the Department of History at that time and a capable student of Sir Mortimer in field archaeology, was put in charge of the excavations which were started in 1949. Sri Sharma has been continuing them methodically since then, and has unearthed materials of major structural character and numerous minor finds of outstanding importance, which throw a flood of light on various aspects of the history and culture of ancient India. Among many other interesting finds that were made during the excavation seasons of 1951-56 was the monastery of Ghositārāma where Buddha used to reside at the time of his visits to the place. A comprehensive report of these excavations was duly submitted long ago by Sri Sharma to the Archaeological Department of India for publication, but it is surprising that it has not yet come out of the press.

The present report published by the University of Allahabad in 1960 gives a full and detailed account of Sri Sharma's work at the site during 1957-59. He concentrated his attention mostly throughout this period on the extensive defences of the ancient city. In the course of his diggings at the foot of the defences on the outer side near the eastern gate, he lighted upon the remains of a brick altar in the rough outline of a bird with outspread wings and some terracotta and skeletal remains of a man and a few animals. These, according to him, represent the recognizable traces of the *Syenaciti* (an altar in the shape of a bird) on which a Vedic sacrificer would immolate a man (*Puruṣamedha*) and a few animals. He has given highly plausible reasons for his explanation of these finds, and when this is finally and unanimously accepted by all scholars it will certainly be regarded as one of the most outstanding of major archaeological discoveries during recent years.

Sri Sharma's sumptuous and scholarly report, copiously and beautifully illustrated, is divided into two parts. The first part consists of eight chapters

dealing with introductory matter (1), stratigraphy and chronology (2), layout of the excavated area (3), tools, weapons, pottery, terracotta figurines, coins and seals unearthed and their respective natures (4-7), and, lastly, the *Śyenaciti* of the *Puruṣamedha* (8). The discovery accounted for in the last chapter of this part was, however, of so much importance that he thought it necessary to present all relevant information about the Vedic ceremony of *Agnicayana* and *Puruṣamedha* from ancient texts in a separate part (part two, chapters 9 and 10).

The introductory chapter contains in a short compass a review of the recent discoveries in India of the Indus civilization and their relation with the earliest remains of Kauśāmbī culture unearthed by him. The defences and the pottery finds of the old city, going back to the first centuries of the first millennium B.C., show that it had developed as a town fully equipped for its protection in the model of the Harappan citadel by that time—an achievement for which the people of the painted greyware pottery culture were not responsible. A branch of these people, presumed by all scholars to be the Aryan immigrants, came to Kauśāmbī in its second cultural stage. The pottery remains also prove that Kauśāmbī had a close link with Navdatoli as they were analogous to pottery types of Harappan origin in Western India. But Sharma at the same time has maintained that the urban revolution in the Gangetic Valley, of which the early city of Kauśāmbī was an older phase, was achieved by a people living in close proximity with the Harappans, presumably an earlier branch of the Indo-Aryans. He has found support of his view in Dr. Hoernle's theory based on linguistic evidence about the wavelike immigrations of the Aryans into India. The urban revolution in the Central Gangetic Valley having its roots in the Indus civilization also 'marked the beginning of the Iron Age in these regions, antedating the N.B.P. (northern black polished) and the P.G. (painted grey) wares'. Sri Sharma has also attempted to prove with the help of different types of arrowheads, terracotta figurines and a few inscribed seals found by him in later strata the incidence of waves of foreign invasions in the Gangetic Valley, beginning with the one by the Bactrian Greeks and ending with the other by the Hūnas. The stratigraphic evidence, according to him, suggests Demetrius as the Bactrian Greek king who invaded Kauśāmbī in the early decades of the second century B.C., a date too early for Menander. It must be observed here that this finding is in some accord with the view of several older scholars, though it runs counter to some other theories (cf. the one supported by Dr. A. K. Narain in his *Indo-Greeks*). Another interesting suggestion made by our author in the introduction is that the *Puruṣamedha* sacrifice on the *Śyenaciti* at Kauśāmbī was performed by Puṣyamitra Śūṅga, the victorious defender of the Gangetic Valley against the invasion of the Bactrian Greeks.

It has been necessary to take an elaborate notice of the introductory chapter for it, in a way, is an epitome of the author's work containing his major deductions based on materials dug out by him. These archaeological data are ably and skilfully arranged and displayed in the subsequent chapters. One or two conclusions that have been affirmed by him in the chapter may not be accepted by all, but there are many which are highly plausible and thought-provoking. A careful study of the subsequent chapters in Part I fully proves how systematic, scientific and efficient Sri Sharma has been in his excavation work. A detailed description of the *Śyenaciti* and its constituents accompanied by several full-page line drawings substantiates in a remarkable manner the cogency and relevancy of his hypothesis. The reviewer was fortunate enough to visit Kauśāmbī several

times after these discoveries had been made, and Sri Sharma's demonstrations on the spot convinced him of the strength and acceptability of his arguments. The learned excavator has been well advised to collect all relevant information from early ritual literature about the Vedic ceremonies of *Agnicayana* for which various types of *Agniciti* (*Śyenaciti* was one among them) were prescribed, and the *Puruṣamedha*, a type of Soma sacrifice in which men and a few animals were immolated. This will help his readers to follow him easily through the technicalities and details of his explanation. We have definite archaeological evidence regarding the performance of *Aśvamedha* sacrifices by little-known and well-known rulers of ancient India (cf. the inscription of Śilavarman found at Jagatgrām near Kālsi, and the inscriptions and coins of Samudragupta and Kumāragupta I), but now has most probably been found a much earlier record of the performance of *Puruṣamedha* by a ruler who might or might not have been the founder of the Śuṅga dynasty.

Sri Govardhan Rai Sharma deserves congratulation of all students of archaeology and Indology for his fine performance as a field archaeologist and a scholar. It is good that he is comparatively young in age, for the still unexcavated portions of the site are so vast in extent that they will require his expert attention and hard and painstaking work for many more years to come. Due credit should also be given to the team of his colleagues and fellow-workers of the University, who have been rendering him ungrudging help during the successive seasons of excavation.

J. N. BANERJEA

26-6-61

VARUṆA—I: *Varuṇa* und die Wasser: Heinrich Lüders. Aus dem Nachlaß herausgegeben von L. Alsdorf. Göttingen. Vandenhoeck and Ruprecht, 1951. Pp. viii + 337 (*in German*).

This is one of the most valuable publications in recent years on Vedic studies. It is from the pen of that great German Indologist Lüders and has been edited and published by Prof. Alsdorf from the MSS. left behind by the author.

In a short Preface to the work the Editor informs that many *lacunae* crept in the MSS. and unfortunately some portions of the work, e.g. one-third of Section VI, the whole of Section VII, etc., were lost altogether. To restore and reconstruct these portions the Editor utilized various sources, viz. records and notes of lectures delivered by Prof. Lüders, rough copy of the work in MSS., etc. In the matter of restoration and reconstruction the Editor has been helped by such eminent authorities like Schubring, Waldschmidt, and Thieme.

The book deals with the problem of *Varuṇa*, 'one of the most important Vedic gods'. While making a detailed study of this particular god the author also comments on some other general Vedic problems of interest.

In a very interesting Introduction, extending over 40 pages, the author gives ample evidence of his critical and unbiased mind and his deep knowledge of the subject. His approach to the subject is direct and style impressive. At the outset he criticizes the attitude and wrong approach to the problems of Vedic studies generally adopted by scholars and discusses the defects and shortcomings of many of the current *theories*. He expresses the opinion that all such scholars should *indeed* stop to think that 'the Vedic R̥sis always used to mean otherwise than what they used to say, and that the language was used only to veil the thoughts'.

In the Introduction the author deals with both Vedic and post-Vedic accounts of the different aspects of *Varuṇa*, 'the god of water, the god of ocean, an Indian Neptune'. Having explained the significance of the term *Rta* (Truth, True) Lüders agrees with Oldenberg (*D. Religion des Veda*, 199) that *Rta* is the responsibility of *Varuṇa*. He observes that the concept of *Rta* did not originate in India for the first time and discusses the Indo-Iranian traditions in this connection.

The whole work is divided into eleven sections.

Section I deals with *Varuṇa* as he has been represented in the Epic and Classical literatures, in the *Samhitās* and *Brāhmaṇas*, in the *Ṛgveda*—*as dwelling in the waters and in the Heaven*. Section II explains *the three divisions of the Heaven*. In the R.V. we have the idea of the three divisions of the Universe. Three heavens, three spaces, three earths are known to us from the time of the *Brāhmaṇas*. Having explained the implications of the expression *śaḍ urvīḥ* in the A.V. and later Vedic literature the author explains *sapta devalokāḥ* and the seven worlds. *Rocanā* mostly appearing with *divāḥ* is a special Vedic term for the invisible part of the Heaven where the gods live and *nāka* is the visible part where the constellations shine. These two important Vedic terms are discussed in detail in this section. *The Ocean* is discussed in Section III in which the author first makes a study of the form of the earth which is shown as a 'four-cornered one'. Then he proceeds on to explain (i) the *World-Ocean* as represented in the *Veda*, (ii) the *Divine-Ocean*, and (iii) the *underground waterflow* and the *primeval water*, and it is shown that besides the mythical ocean the Vedic seers also speak of a real *samudra* which is certainly the *Indian Ocean*.

Section IV dwells at length on the problem of *the Rivers (Sindhu)*. In later Sanskrit literature *Sindhu* means 'river' as well as 'ocean' and it is also the old name for the river *Indus*. The Vedic people knew of divine and earthly rivers and indicated both of them by the term *Sindhu*. The author discusses *Sindhu* first as the earthly river and then as the river in the Heaven and it is followed by an interesting essay on the *seven Sindhus*.

In Section V, one of the most interesting and important sections of the present volume, the author discusses the problem of the *Vṛtra*-fight in all its details. Many scholars, viz. Oldenberg, Hillebrandt, Winternitz, etc., have discussed this problem but nowhere do we get such a detailed critical study of it. The *Vṛtra*-myth has variously been interpreted as a *nature*- or a *storm*- or *winter*-myth. As in the later Epic and Classical literatures *Indra* assumed the character of a *rain-god*, the *Vṛtra*-myth came to be regarded as 'a mythological form of expression for the events of storm'. Oldenberg in his *D. Religion des Veda*, 136, supported only by Hillebrandt, was the first to raise objections against such ideas. Lüders does not believe in the *theory* that the Vedic seers should always use a metaphor and never should they say anything direct to express their ideas! Drawing on materials from all possible sources the author presents us a very informative and interesting essay on the subject and does not find any reason to think that the *Vṛtra*-fight really points or alludes to any 'climatic event'. He thinks it possible that the *Vṛtra*-fight was regarded by the Vedic priests as some 'form of *Creation*-myth'. Section VI is a study on *Soma* where the relation between *Soma* and the waters flowing on both sides of the *visible heaven* is discussed. Section VII deals with *the four streams* discussing in this connection *the division of divine streams* as we have it in the *Purāṇas*, *world-rivers* in Buddhist Cosmology, the *four divine streams* in the *Vedas*, and the *four world-streams* and the *dvīpa*-theory of the mediaeval period. Section VIII is devoted to a study of *the Sun* in the (divine) water closely connected with which is Section IX where the Sun is discussed as

the giver of rain. Samudra in rocks is the topic dealt with in Section X and it is observed that the 'divine ocean, in which the waters, *Soma*, and the constellations exist, is in a *rock*, an enclosed *stone-reservoir*'. 'It is for this reason that in the *Vṛtra*-fight Indra always fights against the *mountain*.'

The present work ends with an interpretation and explanation of the term *Upahvarā*, a term which occurs in the Veda in five places and almost in each place in a different sense. Lüders discusses all these five places along with the translations and interpretations of the term by Geldner and observes that he has no doubt '...that in *Upahvarā* we have before us again a term for the *water-reservoir* in the highest Heaven'.

The present volume thus enlightens us on many difficult problems relevant and necessary for the understanding of the Vedic god *Varuṇa*. Numerous quotations from original sources are given for a correct understanding of the author's arguments. We wish that for the benefit of a greater number of scholars an English translation of this valuable work could be published.

BISWANATH BANERJEE

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AQUATIC VEGETATION OF DAMODAR VALLEY

I. PHANEROGAMIC FLORA OF FRESHWATER PONDS AND MARSHY LANDS WITH PARTICULAR REFERENCE TO DAMODAR-EDEN CANAL AREA OF WEST BENGAL

By P. KACHROO*

(Communicated by Sri S. K. Saraswati)

INTRODUCTION

The ponds and reservoirs within the Damodar Valley (Fig. 1A) are interesting for the unique plant life they contain. The vegetation in the ponds is, however, conspicuously uniform and appears to represent a natural and distinct unit in the flora of the valley.

Notwithstanding the fact that aquatic plants are of great aesthetic value and are of great utility for fish and wild life, most of these plants are intimately associated with breeding of anopheline (and other) mosquitoes—providing food and shelter for their larvae—and, therefore, constitute a major concern in antimalaria campaigns.

The various considerations outlined above suggested that a thorough study of aquatic plants of the valley would prove useful in the understanding of the part played by them in the bionomics of mosquitoes (Kachroo, 1959); in aquatic wild life management (Kachroo *in sched.*); from the standpoint of isolating a natural vegetational element of the flora of Damodar Valley; and also in studying relatively simple factors in the isolation and distribution of aquatic plants of ponds (and reservoirs).

This work was started in the autumn of 1954. Since then a majority of ponds and other aquatic and marsh habitats within the lower valley and those in the vicinity of the reservoirs in the upper valley have been visited and studied.

In the *lower valley* (Fig. 1A) intensive and extensive studies were restricted to District Burdwan (and Hooghly), the main objects being to record and determine (as far as possible) association and bearing of aquatic vegetation on the breeding of anopheline mosquitoes (particularly *Anopheles philippinensis* Ludlow) and also to observe various limnological factors determining the composition of the floral changes, annual or artificial, in the ponds of this area; the latter has received attention in this paper and the former forms substance for Part II of this study.

The following villages were selected within the Damodar-Eden Canal area of West Bengal (Fig. 1B): Silampur, Rhondia, Babla, Galsi, in and around Burdwan town, Krishanpur, Chikanda, Nandipur, Boichi (all within the existing irrigation area); Kolkol, Pursha, Saktigarh, Rasulpur, in and around Memari, Chotkhandi and Alipur (all in existing unirrigated area). Since no apparent or vital differences were noted in the floral compositions of the ponds in the two regions, no particular significance was attached to this aspect of investigation.

In each of the villages, Babla, Galsi, Krishanpur, Nandipur, Kolkol, Pursha, Chotkhandi and Alipur, two or three ponds were selected for weekly

* At present, Editor, Indian Council of Agricultural Research, New Delhi.

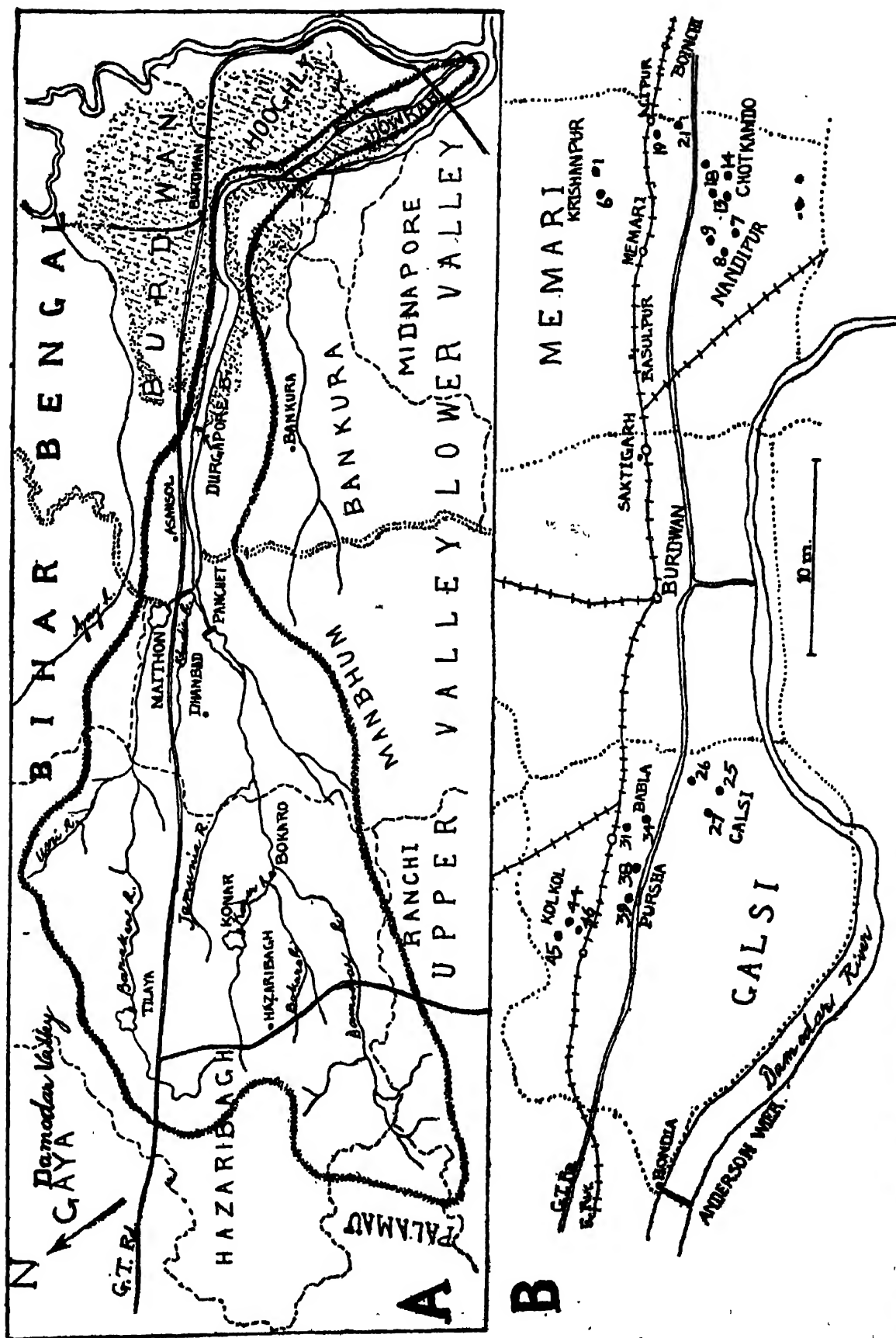


Fig. 1. Damodar Valley. A, showing location of reservoirs in the upper valley and irrigation commanded area (shaded) in the lower

observations. The latter included an account of general aquatic vegetation (and algae) intimately associated with anopheline larvae, nature, pH and depth of water, etc.

A complete collection of flowering plants, algae and other cryptogams of the areas investigated is deposited in the herbarium of the Malaria Research Laboratory at Burdwan.

DAMODAR VALLEY: A BRIEF DESCRIPTION

The Damodar River¹ basin lies between 84·8° and 88·4° E. longitude and 22·2° and 24·6° N. latitude and is spread between the States of Bihar and Bengal. It covers an area of about 23,309·91 sq. km. (Bose, 1948). The valley is broadest around the region where the Damodar and its chief tributary, the Barakar, meet and most of its tributaries arise in the District of Hazaribagh. Below Asansol, the valley narrows down rapidly.

The Damodar Valley is roughly divided into two zones—the *upper* valley and the *lower* valley, the line of demarcation being provided by the boundary of (pre-1955) West Bengal State.

Topography of the valley is variable: 27·5 per cent lies below 152·4 m., 16·5 per cent above 457·2 m. and the highest peak (alt. 1,219·2 m.) is represented by the Parasnath Hill. The upper valley is hilly, a monadnock, rolling plateau composed of laterite soils formed by uplifted peneplain, the surface often with scarp-like or/and sharp edges between pairs of (tributaries) river valleys.² The lower valley is a flat alluvial plain; the latter is dominated by decomposition of sand, silt and clay brought by the Damodar and its tributaries. It has a gentle gradual rise from south-east to north-east with a slight amount of natural undulation in the extreme north-west. In the lowermost limits the only natural highlands are along the river (or stream) banks. The right bank is generally of a higher elevation than the left, the land along the latter being irrigated by the Damodar Canal which in turn feeds the Eden Canal below Burdwan, the water being diverted into the canal by (low) Anderson Weir across the Damodar at Rhondia. During low flow seasons the canals remain dry (see Fig. 1A for the future irrigation commanded area).

The *geologic formations* (Fig. 2) consist mainly of metamorphic rocks (granite-gneisses with associated schists) and these are overlain by sedimentary rocks (sandstone and shales) containing large coalfields. The gneiss is the hardest rock within this area, but on hill-sides it is decomposed to a considerable depth.

The upper valley (and the middle valley) is composed of crystalline rocks on which are preserved outliers of gondwana sediments here and there. Eastwards, it is fringed with laterite rocks. Crystalline rocks, chains and dykes are a common feature, bigger patches of gondwana lie near the source of the Damodar, smaller ones in the Barakar valley.

¹ The River Damodar (Deonad in its upper course) rises from Kahmar-Pat (alt. 1,068·01 m.), a high, flat-topped hill on the north-western edge of Ranchi plateau (District Hazaribagh), and is about 540·74 km. long. Till recently it was an unmanageable river and while in spate caused great misery and disaster in Western Bengal. The first proposal to control floods by means of reservoirs (on this river) was considered in 1863 and later vigorously stressed upon by a number of West Bengal Government engineers, notably Gernault (1864), Heywood (1866), Horn (1902) and Glass (1918-19). The disastrous flood of July, 1943, made it still more imperative to control this river through construction of multipurpose reservoirs in its upper limits (cf. *Rec. Bengal Govt.*, 1852-1923, and *Rep. Damodar Flood Engr. Comm.*, 1944).

² The upper valley will be included in a subsequent investigation.

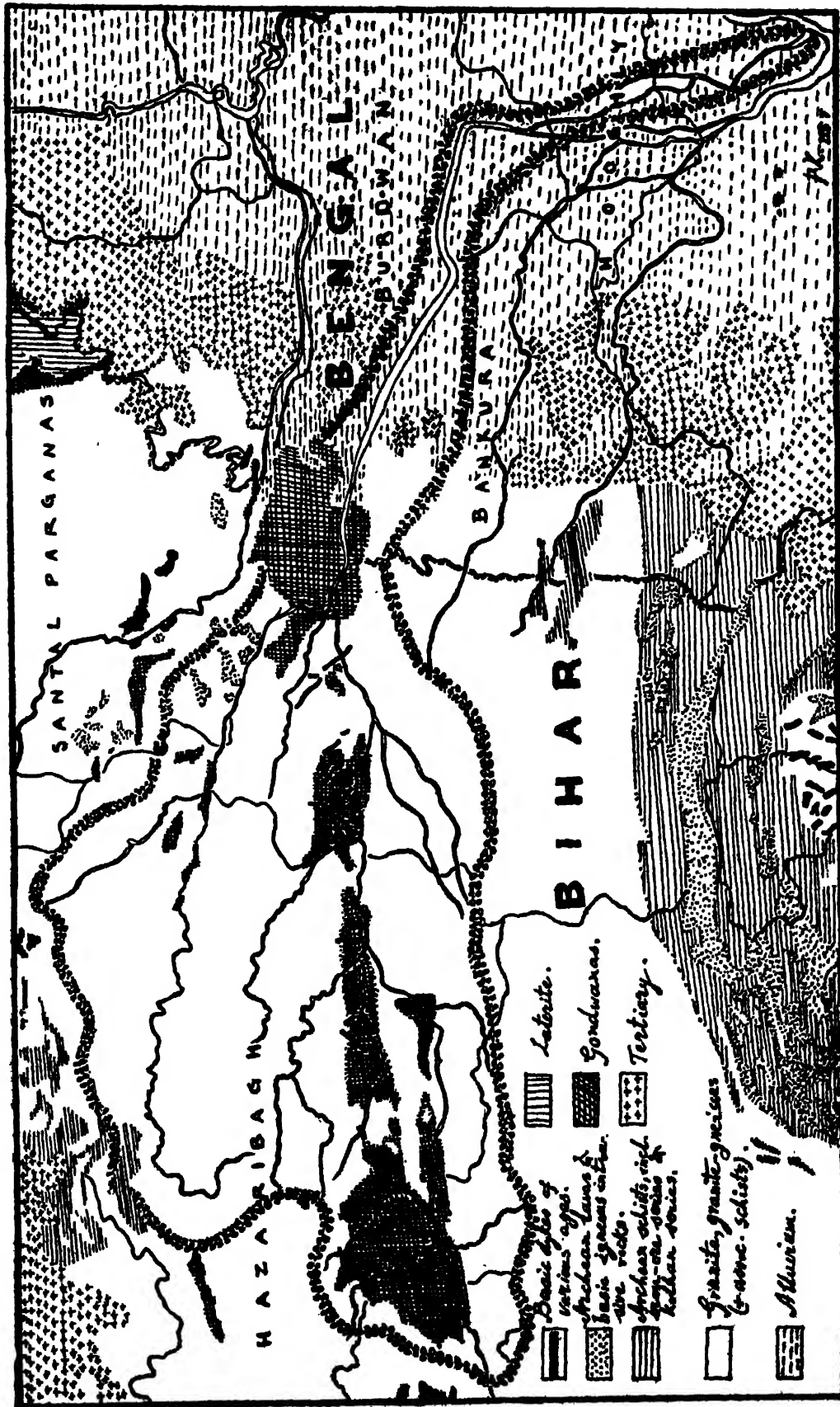


FIG. 2. Geological map of Damodar Valley (from Prel. Mem. Unified Developmt. Damodar River, 1945).

The main minerals known are mica, iron ore, fire-clay, limestone, barytes, bauxite, lead, silver, steatite, copper and mineral springs (Khedker, 1950). The Dhanbad-Asansol sector is richest in minerals and practically no minerals occur in the lower valley. Mineral springs are found at Kawa, Gandhawari, Duai and Suraj-khund (District Hazaribagh).

Climate: It is on the whole of the monsoon type, characterized by dry and comparatively cool season from mid-October to mid-February, and dry and hot season from March to May (or June) and warm, wet season from (June) July to September. July-September (October) is the normal rainfall period and the average rainfall is about 5.56 m. per annum, decreasing northwards. In the Districts of Burdwan and Bankura (the lower valley), the climate is transitional from moist, steamy type in the plains to fresh, bracing type in the rolling plateau. In Manbhum and Santal Parganas the climate is much drier.

In the area under consideration, April-May (June) were the hottest months and December-January (February) the coldest months, July-August received highest rainfall, and maximum humidity was recorded for July-September period (Table 1).

*General characters of vegetation*³

The catchment basins of the Damodar and Barakar rivers are generally denuded of forests and have large tracts cut deep by gullies. However, portions of land near the mouth of various tributaries are under terrace-cultivation. Nevertheless, it is the upper valley which is largely forested. In the lower valley the natural vegetation is confined to sandy 'char' lands in the river-bed, higher alluvial deposits like embankments, abandoned gardens, ruins and marsh lands. The lowermost hinge (deltaic area) has paddy fields and gardens surrounding villages.

Bose (1948) recognized the following vegetational types in the whole valley: *sal* forests, mixed evergreen forests, secondary thickets and jungles, *palas* forest and coppice, *mahua* grades, secondary vegetation of coalfields, savannah of sandy tracts along the river, xerophytic scrub jungle, *bagans* and the marshland vegetation.

In the Hazaribagh tract the flora is essentially tropophilous with a strong tendency towards xerophyllous nature. The *sal* is the most characteristic tree of this region and the chief formations are those of *sal*, *Terminalia*, evergreen and mixed forests. *Terminalia* formation is chiefly associated with species of *Bombax* and *Sterculia*. The mixed forests are mostly in open lands, represented by *Woodfordia*, *Boswelvia*, *Lagerstroemia*, *Adina*, *Mitragyna*, *Anogeissus*, *Grewia*, etc., and the *sal* formations are associated with trees of dry-mixed types, *Anogeissus*, *Sterculia*, *Cochlospermum*, etc. The other species found are *Careya*, *Terminalia*, *Pterocarpus*, etc. In the Manbhum tract is an abundance of species characteristic of warm, humid regions and it abounds in *sal*, bamboos or mixed forests. The *sal* is associated with *Terminalia*, *Pterocarpus*, *Mangifera*, *Bursera*, *Gardenia*, etc. The most common bamboo, *Bambusa arundinacea*, and relatively less common *Dendrocalamus strictus* constitute the bamboo formation. The mixed forests have species of *Leea*, *Rubus*, *Pilea*, *Grewia*, *Bridelia*, *Melia*, *Capparis*, *Diospyros*, *Strychnos*, *Randia*, etc.

³ Prain (1905) gave the topography and vegetation of what may be termed the lowermost hinge of the valley and enumerated separately (in his introduction) the species of marshy places, rice fields and ponds. No descriptions were appended.

Haines (1925) in his *Botany of Bihar and Orissa* discussed and enumerated the flora of the upper valley and listed aquatic vegetation of the various places.

TABLE I
Meteorological data for District Burdwan, 1954-58

Year	Temp. °C. Rainfall in cm.	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1954	Rainfall	3.4	0.0	0.0	0.01	3.7	10.1	32.6	37.11	32.8	10.2	0.0	2.7
1955	Rainfall	0.0	0.01	1.3	3.8	12.5	32.6	58.3	41.2	10.3	10.8	5.6	0.0
1956	Max.	—	—	—	—	—	—	—	89	89	86	88	85
	Min.	—	—	—	—	—	—	—	82	80	78	71	65
	Rainfall	0.2	7.8	5.0	5.6	12.5	47.5	37.5	43.2	85.0	17.5	0.6	0.8
	Humidity	—	—	—	—	—	—	—	82	87	84	82	81
1957	Max.	77	81	84	101	107	98	80	90	92	90	85	79
	Min.	60	53	64	82	82	80	78	79	79	71	60	54
	Rainfall	0.12	5.0	2.3	0.0	0.0	50.0	45.0	42.5	2.2	2.1	0.0	0.0
	Humidity	72	57	53	43	45	67	86	86	89	74	91	62
1958	Max.	86	86	86	101	102	97	91	90	90	93	91	87
	Min.	64	67	74	80	82	83	81	81	81	80	73	67
	Rainfall	3.1	5.4	0.02	5.0	5.1	12.5	27.5	0.09	16.3	16.0	0.02	0.0
	Humidity	78	76	65	76	81	80	89	87	86	81	83	80

In the Districts Burdwan and Bankura the existing forests are composed of *sal* with a considerable percentage of *Pterocarpus marsupium*. The other species represented are *Lagerstroemia parviflora*, *Diospyros melanoxylon*, *Oleistanthus collinus*, *Butea frondosa*, *Combretum decandrum*, etc. These latter species often form non-association at the cost of *sal* forests.

VEGETATION OF AQUATIC AND SEMI-AQUATIC HABITATS

The plants growing in and around water collections, ponds, depressed and fallow lands and paddy fields can be conveniently classified into three groups:

- (a) *Terrestrial*: Normally growing in dry soil, usually perishing within a month or in a shorter time after inundation.
- (b) *Marshy*: Plants in soils which remain saturated with water during a major portion of their growing season, normally not perishing during partial inundation.
- (c) *Aquatic*: Normally growing in water during a major portion (or always) of the growing season, either rooted in mud or free floating, usually perishing during prolonged dewatering. (A number of them perennate unfavourable periods through underground modified stems.)

Table 2 lists typical plants of the above groups in relation to the various plant types (of ponds) enumerated earlier (Kachroo, 1956):

TABLE 2

Representative species of terrestrial, marshy and aquatic plants arranged against ten basic plant types

Type	Terrestrial	Marshy	Aquatic
1. Woody	'Mahua'	<i>Acacia</i> spp.	' <i>Phoenix paludosa</i> ' (in sensu lato)
2. Leafy	<i>Croton sparsiflorus</i>	<i>Aeschynomene aspera</i>	<i>Sphenoclea zeylanica</i>
3. Erect naked	<i>Chrysopogon aciculatus</i>	<i>Scirpus articulatus</i>	<i>Eleocharis plantaginea</i>
4. Flexuous	..	..	<i>Ludwigia parviflora</i> , <i>Polygonum hydrophyllum</i>
5. Floating leaf	..	..	<i>Nymphaea</i> 'lotus', <i>Limnanthemum indicum</i>
6. Floating mat	..	..	<i>Jussiaea repens</i> , <i>Enhydra fluctuans</i>
7. Carpet	..	..	<i>Pistia stratiotes</i>
8. Submerged	..	..	<i>Ceratophyllum demersum</i>
9. Fleuston	..	..	<i>Azolla pinnata</i>
10. Microscopic	..	..	<i>Microcystis aeruginosa</i>

In general, the terrestrial species occurred mainly in the regression zone, wet land species within the fluctuation zone or down to the lower limits of the post-monsoon level zone, and aquatic plants often overlapped with marshy species and extended out into water below the post-monsoon level zone. A diagrammatic representation of vegetation and pond contour is illustrated (Fig. 3).

Along the river (and canal) banks the most common species encountered were *Alpinia allughas*, *Asystasia gangetica*, *Barringtonia acutangula*, *Bergia verticillata*, *B. ammanoides*, *Cochlearia deflexum*, *Cyperus procerus*, *C. distans*, *C. articulatus*, *C. corymbosus*, *C. radiatus*, *Evolvulus nummularius*, *Securinega virosa*, *Lantana indica*, *Leucaena glauca*, *Lippia geminata*, *Phragmites karka*, *Polygonum hydropiper*, *P. glabrum*, *Pongamia glabra*, *Solanum sisymbriifolium*, *Spilanthes acmella*, *Tamarix gallica*, *T. dioica*, *Trewia nudiflora*, *Wedelia calendulacea*, *Xanthium strumarium*, *Croton sparsiflorus*, *Ageratum conyzoides*, *Acacia* spp. and *Kyllinga monocephala*.

It may be pointed out here that in this paper we are mainly concerned with aquatic plants and most of these grow in ponds⁴ which provide them a perennial habitat. In the lower valley the majority of these ponds lie near or within the habitations, and were primarily dug either for fishing or to meet the daily requirements of water or for both. Even though the ponds are well banked, there is enough scope for outside water entering into them during rains, a provision being made for the same by the local villagers for storing water. These are not natural ponds!

Ponds were occasionally disturbed and this interference often caused a shift in the local fauna and flora. However, 'normally' these ponds lie undisturbed and the species growing in this quiet water or rooting near the margins usually flower abundantly. It was observed that the main variables in the nature of these ponds were depth of water, presence of water throughout the year, type of substrate (and quality of water).

It was also noted that in general deep water usually produced the same effect on plants as that produced by swift currents, i.e., tendency towards production of vegetative or sterile shoots only. This was significant in case of *Potamogeton*, *Najas* and *Ceratophyllum*. These species often grew in deep water where they vegetated freely, but rarely, if ever, were observed to produce flowers.

It was further observed that in general the influence of such factors as (a) quiet water, (b) shallow water or lowering of water level, and (c) increased exposure to sunlight or desiccation had a great bearing on production of flowers. Species which actually grew in water throughout the year remained green and active, at least in vegetative state. However, during winter most of the aquatic plants remained in vegetative condition; this was especially true of *Potamogeton*, *Hydrilla*, *Najas*, etc. Plants like *Limnanthemum* and *Nymphaea* flowered in winter as well as during other times of the year.

Species growing along banks of ponds partly in and out of water,

⁴ Pond is here regarded as a very shallow body of standing water in which relatively quiet water and extensive plant occupancy are common characteristics (cf. Welch, 1952, pp. 15-16). On the basis of this definition all bodies of standing water locally called *dighi*, *pukur*, *doba* or *talao*, as well as depressed lands and fallow lands, are regarded as ponds so far as this study is concerned. However, experience has shown that a considerably large number of these *dighis*, *pukurs*, etc., are actually wide and deeper depressed lands whose real nature is 'exposed' during periods of extreme drought, their vastness in normal seasons giving an illusion of a *dighi* or a *pukur*! (see also pp. 282-283). Real deep ponds are very few indeed.

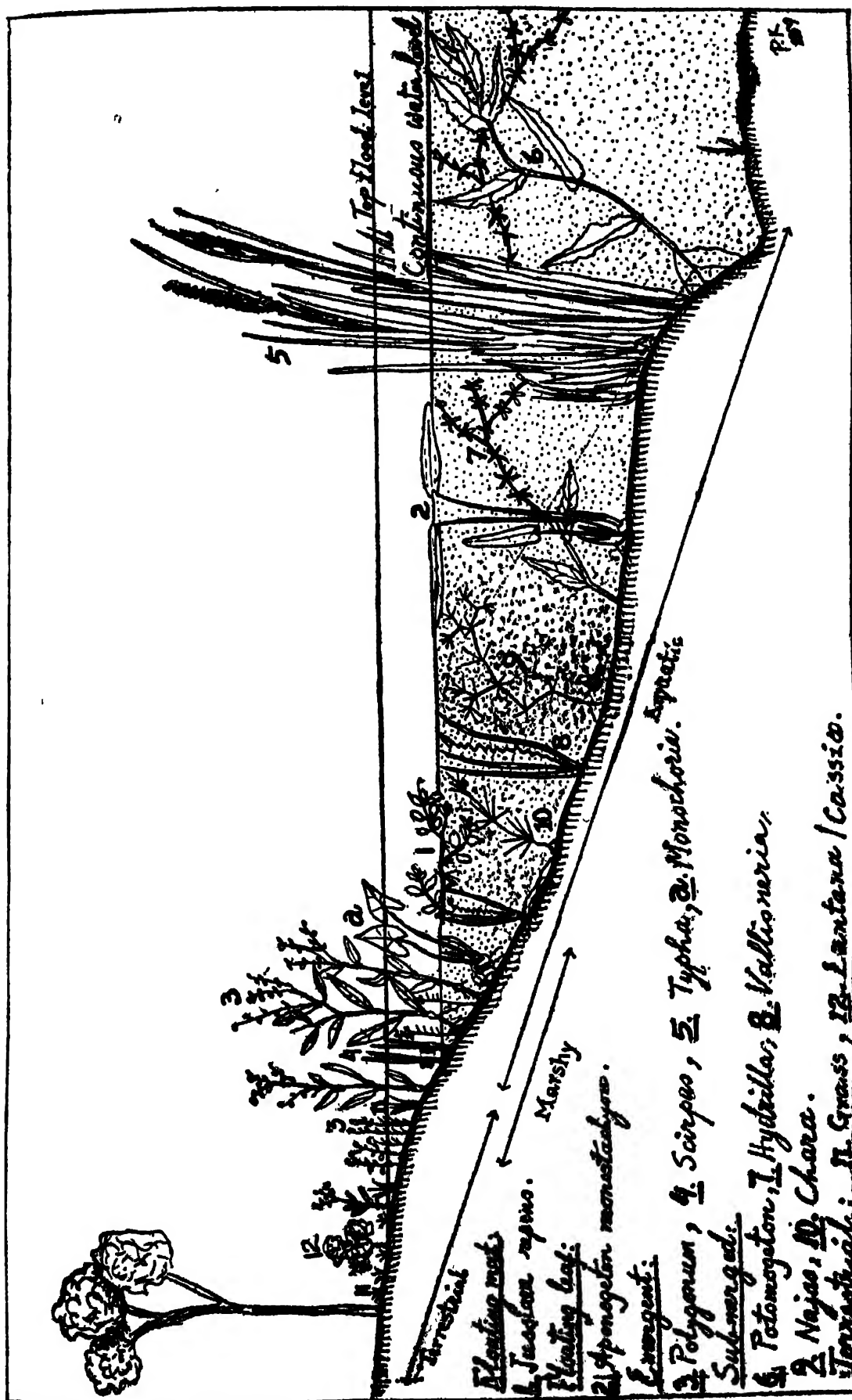


FIG. 3. Generalized contour distribution of some basic plant types along a pond (diagrammatic).

Aeschynomene aspera, *Neptunia oleracea*, dropped their leaves and remained dormant over most part of winter and spring.

Of the 237 species⁵ collected in and around aquatic habitats, the following were most commonly found in this region and nearly all of them were associated with breeding of mosquitoes:

Azolla pinnata, *Ceratophyllum demersum*, *Chara zeylanica*, *Commelina salicifolia*, *Eichornia speciosa*, *Hydrilla verticillata*, *Ipomoea aquatica*, *Jussiaea repens*, *Lemna minor* and *polyrrhiza*, *Limnanthemum indicum/cristatum*, *Limnophila* (various spp.), *Marsilea quadrifoliata*, *Monochoria hastaeifolia*, *Najas foveolata*, *Nymphaea* spp., *Echinochloa colonum*, *Hymenachne pseudo-interrupta*, *Pistia stratiotes*, *Polygonum glabrum* (*Potamogeton crispus*), *Sagittaria guayanensis*, *Scirpus articulatus*, *Hygrophorhiza aristata*, *Cyperus* spp., *Alternanthera sessilis*, *Aeschynomene aspera* and *Utricularia* spp.

Of these species the dominant elements were *Marsilea quadrifoliata*, *Azolla pinnata*, *Lemna minor*, *Pistia stratiotes*, *Jussiaea repens*, *Nymphaea* 'lotus', *Hydrilla verticillata*, *Limnanthemum indicum/cristatum* (*Alternanthera sessilis*), *Chara zeylanica*, *Spirogyra* and grasses.

It was interesting to note that such species as *Enhydra fluctuans*, *Aponogeton monostachyon*, *Vallisneria spiralis*, *Eleocharis plantaginea*, *Myriophyllum indicum* and *tuberculatum* were restricted to particular ponds. In ML 14 during 1954-58 the only vegetation recorded was a patch of *Aponogeton crispus* in December, 1954, and a patch of 2-3 plants of *Nymphaea rubra* in October-November, 1958. *Lagarosiphon roxburghii* was only collected a couple of times during 1954 in Hooghly (and Memari). In October, 1958, *Sphenoclea zeylanica* appeared suddenly in Shankipukur at Kolkol and disappeared completely by December.⁶

Lemna, *Azolla*, *Pistia*, *Commelina* and *Nymphaea* occurred practically in all types of situations, but *Nelumbo nucifera* (probably cultivated) was less commonly found. *Salvinia natans* was also noted to have the capacity to grow in all types of water. *Eichornia speciosa* did not normally prefer clean water.

In rare instances only one or two or no plants grew in a few ponds. The following ponds are examples of such paucity of gregarious vegetation:

Pond/locality		Aquatic plants found	
(Old) ML 14 (Chotkhando)	1954	<i>Nymphaea</i> 'lotus' (central few plants)	
	1955	June to September as above, then no flora	
	1956-58	No flora	
GL 39 (Pursha)	.. 1954	<i>Cryptocoryne ciliata</i> (5-7 plants)	
	1955	<i>Aeschynomene aspera</i> , <i>Marsilea quadrifoliata</i> , <i>Jussiaea repens</i> (all rare)	
	1956-58	No flora	
GL 46 (Kolkol)	.. 1954	A few plants of <i>Nymphaea rubra</i> , <i>Utricularia flexuosa</i> , <i>Najas</i> spp., <i>Jussiaea repens</i>	
	1955	<i>Limnophila racemosa</i> (very common along recession zone), a rare <i>Aeschynomene aspera</i> and common floating masses of <i>Cladophora glomerata</i>	
	1956-58	No flora	

⁵ A list of plants is given in Appendix I.

⁶ *Sphenoclea zeylanica* is otherwise reported as a 'general weed' of rice fields and *khils* in Howrah and 24-Parganas (West Bengal).

The following species showed great tendency towards formation of pure colonies or mats:

<i>Commelina salicifolia</i>	<i>Utricularia</i> (various spp.)
<i>Ceratophyllum demersum</i>	<i>Trapa natans</i>
<i>Hydrilla verticillata</i>	<i>Enhydra fluctuans</i>
<i>Limnanthemum indicum/cristatum</i>	<i>Hygrophiza aristata</i>
<i>Najas foveolata</i>	<i>Limnophila racemosa</i>
<i>N. minor</i>	<i>Jussiaea repens</i>

However, it was also seen that occasionally plants occurred as solitary, either dispersed within an 'association' or rarely all alone (ca. 1-3 plants); the former occurrence was rather more common. Examples are listed below:

<i>Alisma plantago(?)</i>	<i>Lagarosiphon roxburghii</i>
<i>Callitriche heterophylla</i>	<i>Myriophyllum indicum</i>
<i>Ceratopteris thalictroides</i>	<i>Scirpus supinus</i>

DEPTH OF WATER AND NATURE OF SUBSTRATUM IN RELATION TO AQUATIC VEGETATION

A combination of water, slightly deep with currents having visible movement together with mud or mud-and-sand substratum is apparently best suited for a luxuriant production of aquatic vegetation.

Very swift and deep water are least conducive to aquatic growth and similarly too much sand or mud eliminates the mud-loving or sand-loving species, respectively. However, it may be recalled here that ponds are either deep or shallow, the latter category including the majority of *depressed* lands visited during the last four years. The following is a list of species which favour *deep* or *shallow* water, and it is evident from the list that a species need not necessarily grow exclusively in shallow or deep water but merely that it may grow most often in either of the two situations. Thus species occurring under both conditions are rather ubiquitous.

Species favouring shallow water

Aeschynomene aspera
Ceratophyllum demersum
Chara zeylanica/fragilis
Hydrilla verticillata
Ipomoea aquatica
Myriophyllum indicum/tuberculatum
Najas foveolata
Nitella acuminata
Potamogeton indicus
Utricularia spp.
Limnophila heterophylla

Species favouring deep water

Ceratophyllum demersum
Chara zeylanica
Hydrilla verticillata
Jussiaea repens
Limnanthemum indicum/cristatum
Myriophyllum indicum
Najas foveolata
Nelumbo nucifera
Potamogeton crispus/indicus
Typha angustata
Utricularia spp.

Of the species common to both the habitats, it may be pointed out here that *Ceratophyllum*, *Hydrilla* and *Najas* are usually common in deep water, whereas *Utricularia* (typically *U. racemosa*), *Myriophyllum* and *Chara* grow best in shallow water.

Usually all species favour quiet water where they have optimum development. Most common species of this category are *Myriophyllum*, *Jussiaea*, *Trapa natans*, *Limnophylla*, *Pistia*, *Lemna*, *Hygrophiza aristata*, *Typha*, *Enhydra fluctuans*, *Lagarosiphon*, *Sagittaria* and *Alisma*.

With respect to *substratum*, the ponds can be classified into three broad types: mud, sand-mud, \pm rocky. Konar reservoir is a typical illustration of rocky conditions and so far (1957) a true aquatic plant has not been collected from there. This type is rare. The mud-substrate is rather the normal type for the whole valley and very few ponds do actually possess

sand-mud substrate (probably those at Maithon, Panchet and Durgapore may be considered here). The common species under each class are listed below:

Species favouring mud substrate	Species favouring mixed mud-sand substrate
<i>Alisma monostachyon</i>	<i>Chara fragilis</i>
<i>Chara zeylanica</i>	<i>Crinum deflexum</i>
<i>Eleocharis fistulosa/plantaginea</i>	<i>Eragrostis elongata</i>
<i>Monochoria vaginalis/hastataefolia</i>	<i>Eriocaulon quinqueangulare</i> •
<i>Nelumbium/speciosum</i>	<i>Lindernia angustifolia</i> •
<i>Nymphaea</i> spp.	<i>Monochoria hastataefolia</i>
<i>Polygonum glabrum</i>	<i>Ottelia</i> spp.
<i>Sagittaria guayanensis</i>	<i>Polygonum hydropiper</i>
<i>Scirpus articulatus</i>	<i>Potamogeton indicus</i>
<i>Typha angustata</i>	
<i>Vallisneria spiralis</i> ?	

Such plants as *Ammania baccifera*, *Alternanthera sessilis*, *Caesulia axillaris*, *Grangea madaraspata* and *Scirpus supinus* grow both in mixed sand-mud and mud substrate and such species as *Chara fragilis* was never collected from ponds with mud substrate, and conversely *Polygonum glabrum* was never collected from sand-mud substrate. *Phyla nodiflora* was found exclusively restricted to sandy banks.

In the above discussion I have grouped the various species according to their preference for one or other factor, but considerable overlapping was noted in each case. This is natural when factors are considered *singly*, but when we consider a *combination of factors*, e.g., *deep* and *quiet* water, or *shallow* water and *muddy* substratum, a more definite preference is bound to occur, since various combinations of certain environmental conditions favour the occurrence of some species, or an assemblage of species, more so than they do others. Thus *Myriophyllum indicum*, *Potamogeton crispus*, *Ceratophyllum demersum*, *Jussiaea repens*, etc., occur mostly in *deep* and *quiet* water; and such plants as *Sagittaria*, *Alisma*, *Monochoria*, etc., only abound in *shallow* water with *muddy* substratum.

POND CONTOUR IN RELATION TO MARGINAL FLORA

After a prolonged study of the existing ponds it was determined that a majority of them are merely permanent depressed lands and that after prolonged inundation they have assumed pond dimensions. In periods of drought these 'ponds' dry up and this necessitates their 'recasting', the usual practice being either (a) to dig pits here and there to conserve water for domestic purposes (Fig. 6) and also create a better reserve for the future, or (b) to construct a new bund all around (Fig. 5). In the latter case the bottom is flattened. However, in each village there do exist real (though artificial) ponds which have been dug deep, and normally they do not dry up completely during unfavourable periods.

It was further observed that the contour of the ponds was based on the nature of their bottoms—the latter falls under three natural groups:

- (a) Depressed-bottomed (Fig. 4):
 - (i) \pm flat-bottomed (Fig. 5),
 - (ii) hoofprint-bottomed (Fig. 6).

⁷ It was found growing luxuriantly in sand-rocky substratum near Bokaro Barrage during 1958-59.

- (b) Semilunar-bottomed:
 - (iii) Semilunar-bottomed,
 - (iv) staired-bottomed (Fig. 7).
- (c) Cup-bottomed (Fig. 8).

Depressed-bottomed ponds: These ponds were never dug and typical (deeper) depressed lands were usually with profuse growth of surface grasses which invaded far down into the base of the 'pond'. They are either \pm flat-bottomed or the bottom is a large collection of hoofprints, the latter condition caused by human interference when the ponds (nearly) dried up and local villagers dug (large) hoofprints to conserve whatever water was left.

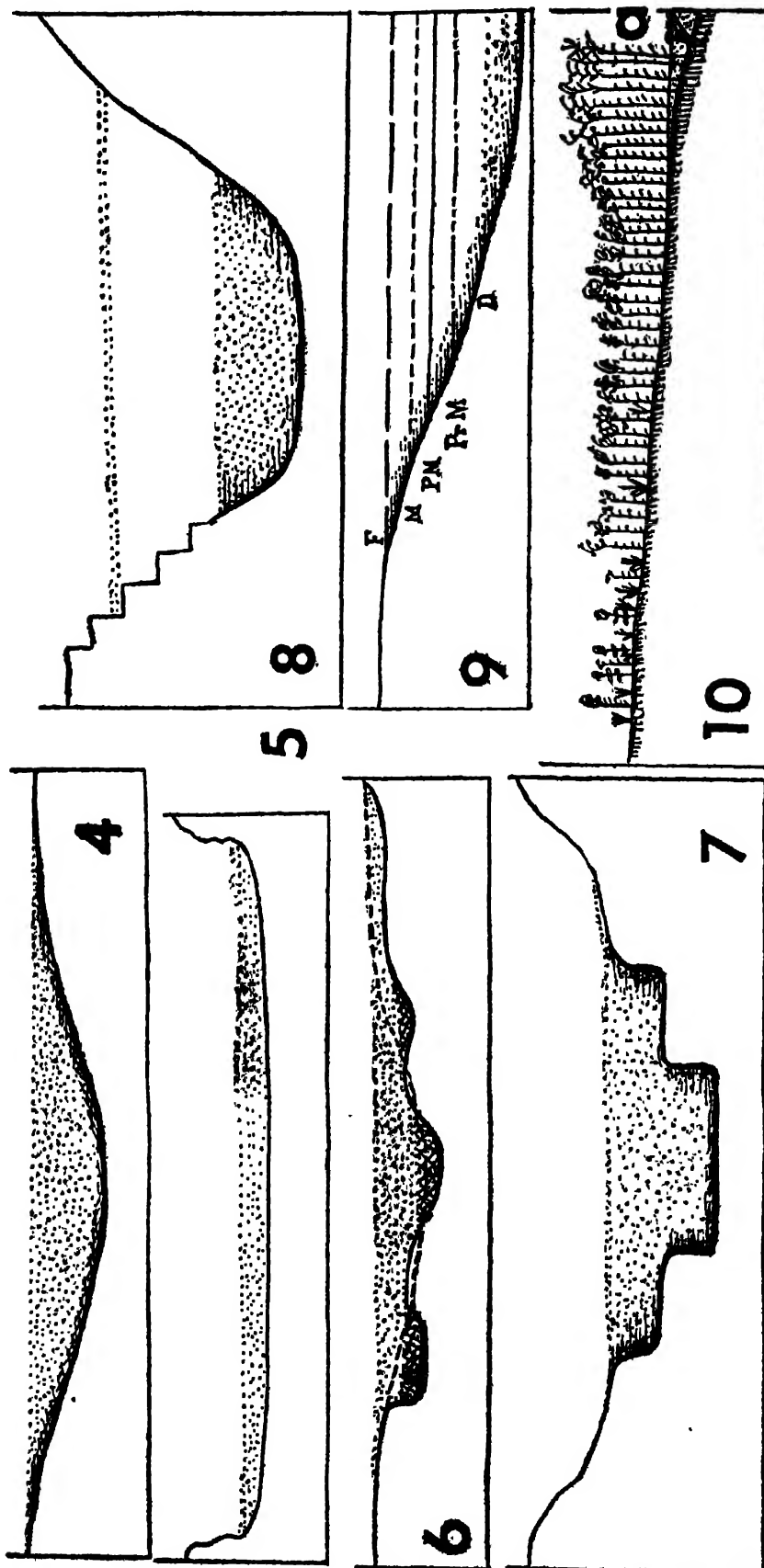
Semilunar-bottomed ponds: They include ponds mostly dug for fishing or for other domestic or communal needs. When such a pond dries up it is recast as a staired-bottomed pond.

Whatever the contour of ponds, the depth of water maintained in each type the same sequence of level *vis-à-vis* monsoons, namely (*drought level*), *pre-monsoon level*, *monsoon level*, *flood level* and *post-monsoon level* (Fig. 9). The zonations caused by these levels in marginal flora have been previously discussed (Kachroo, 1956).

Little variation was observed in limnology of depressed and semilunar-bottomed ponds, since both are best suited for a luxuriant growth of marginal flora. In the shallow depth of clear water grew most of the marginal (*flexuous*) species and submerged plants of low level. The deeper semilunar-types had in addition a \pm luxuriant central flora, usually constituting a single or a couple of species. The *flexuous* associates were mainly *Alternanthera sessilis*, *Limnophila indica*, *L. heterophylla*, *Echinochloa colonum*, *Ludwigia parviflora*, *Eragrostis*, *Commelina salicifolia*, etc. The submerged associates were *Hydrilla verticillata*, *Najas* and *Chara zeylanica*. The central flora when present included species of *Nymphaea*, *Limnanthemum*, and less often of *Nelumbo* and *Pistia*. Occasionally the marginal belt had predominance of *floating mat* species: *Jussiaea repens*, *Hygrophorhiza aristata*, *Enhydra fluctuans*, rarely also *Ipomoea aquatica*. In such cases the central flora was either wholly *floating leaf* (*Limnanthemum*) or often *carpet* or *pleuston*. *Lemna*, *Pistia*, *Azolla*, commonly together or less often *Lemna-Azolla* association only, rarely *Azolla* alone, formed thick carpets over the whole water surface.

In these ponds, even if water level receded, the marginal belt underwent little or a less defined change in the type representation of species, since the water level was already low and provided enough scope for the species to grow in a diffused manner. The regular belts of vegetation were often visible only in deeper ponds. Grasses and sedges were always in a majority and sometimes overgrew other plants, thus causing choking up of the ponds. The only visible water remained in patches, or more often only towards the centre (Fig. 10).

The *cup-bottomed ponds* have two types of banks: steep or with a gradual slope. The former had little or very meagre representation of truly aquatic species and most of the species were representatives of recession zone. The central flora was poor and blue-green algae predominated. In the latter type (i.e., gradual-sloped ones) the slope was gradual and had better capacity to harbour (mostly) semi-aquatic species. During drought the water level oscillated within a zone which had rather steep banks; the latter situation only encouraged grasses and some terrestrial species. In normal periods the marginal flora was either representative of emergent species or of free floating forms (cf. Tentigere: *Salvinia* and *Spirogyra*).



FIGS. 4-8. Pond contour. 4, depressed-bottomed. 5, \pm flat-bottomed. 6, hoofprint-bottomed. 7, stair-bottomed. 8, cup-bottomed—the stairs at left represent a *ghat*.

FIG. 9. Sequence of water level in relation to monsoon (diagrammatic). F, flood; M, monsoon; PM, post-monsoon; PrM, pre-monsoon; D, drought.

FIG. 10. Distribution of plants in nearly choked-up pond; the only aquatic plant *a* is squeezed towards the centre.

In the *cup-bottomed ponds*, on the whole, the marginal flora was adversely affected by decrease in water level since the steepness left little scope for chance inundation and uptake of moisture. Very few submerged species grew here due to lack of an enlarged bottom-mud surface.

In normal circumstances growth and development of the marginal flora was governed by fluctuation in the pond water level. In the pre-monsoon period the marginal flora had a very poor representation of aquatic plants and was mostly represented by weeds which were not normally resistant to an aquatic mode of life, but with the onset of rains a fillip was provided to the growth of truly aquatic plants, and the resistant weeds (which may have been already present) came to form a nice association with floating and truly aquatic emergent species.

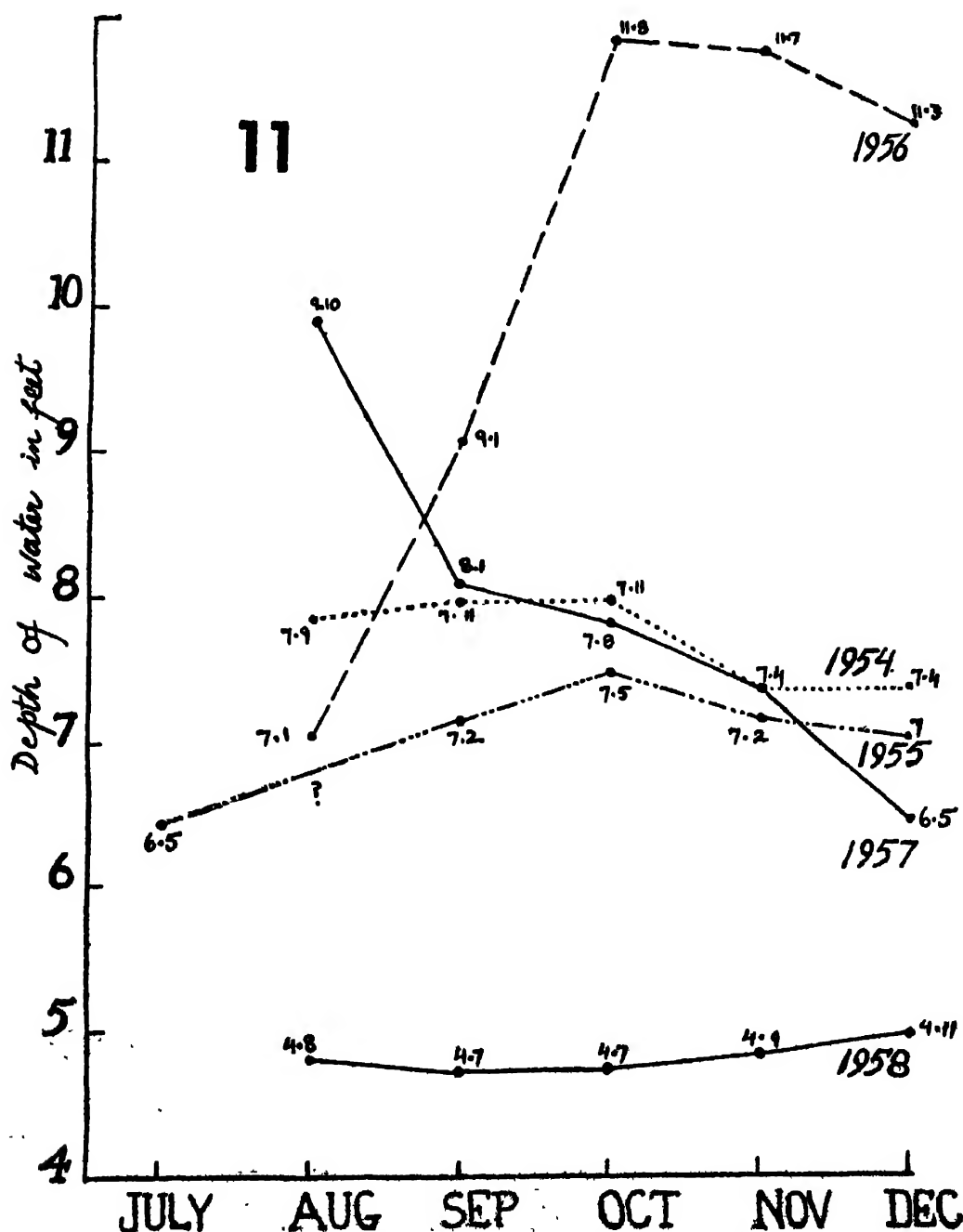


FIG. 11. Comparative depth of water in GL 48 during 1954-58 (data based on weekly observations, but monthly averages only considered for the graph). 1954-56 show a \pm normal curve; in 1957 the water was taken out, 1958 was a drought season.

In the post-monsoon period the water level gradually receded and exposed the marginal belt, finally resulting in the extermination of all aquatic plants.

However, it may be noted that an extraordinary rise in water level (cf. floods) caused submergence of marginal vegetation, consequently the ponds assumed a clear 'shore-line'.

Studies conducted during 1954-58 showed that in ponds, when not subject to human vagaries or monsoon excesses, there was a \pm gradual rise in depth of water from August and this level stabilized during September-November. Afterwards there started, at first insignificant and later quite apparent, gradual recession, the lowest water level being recorded during March-April when a number of freshly laid depressed lands dried up completely. This phenomenon was remarkably illustrated by GL 46 for 1954-56, GL 34 for 1954-55 and 1957, ML 13 for 1954-56, and ML 14 for 1956 (Figs. 11-14).

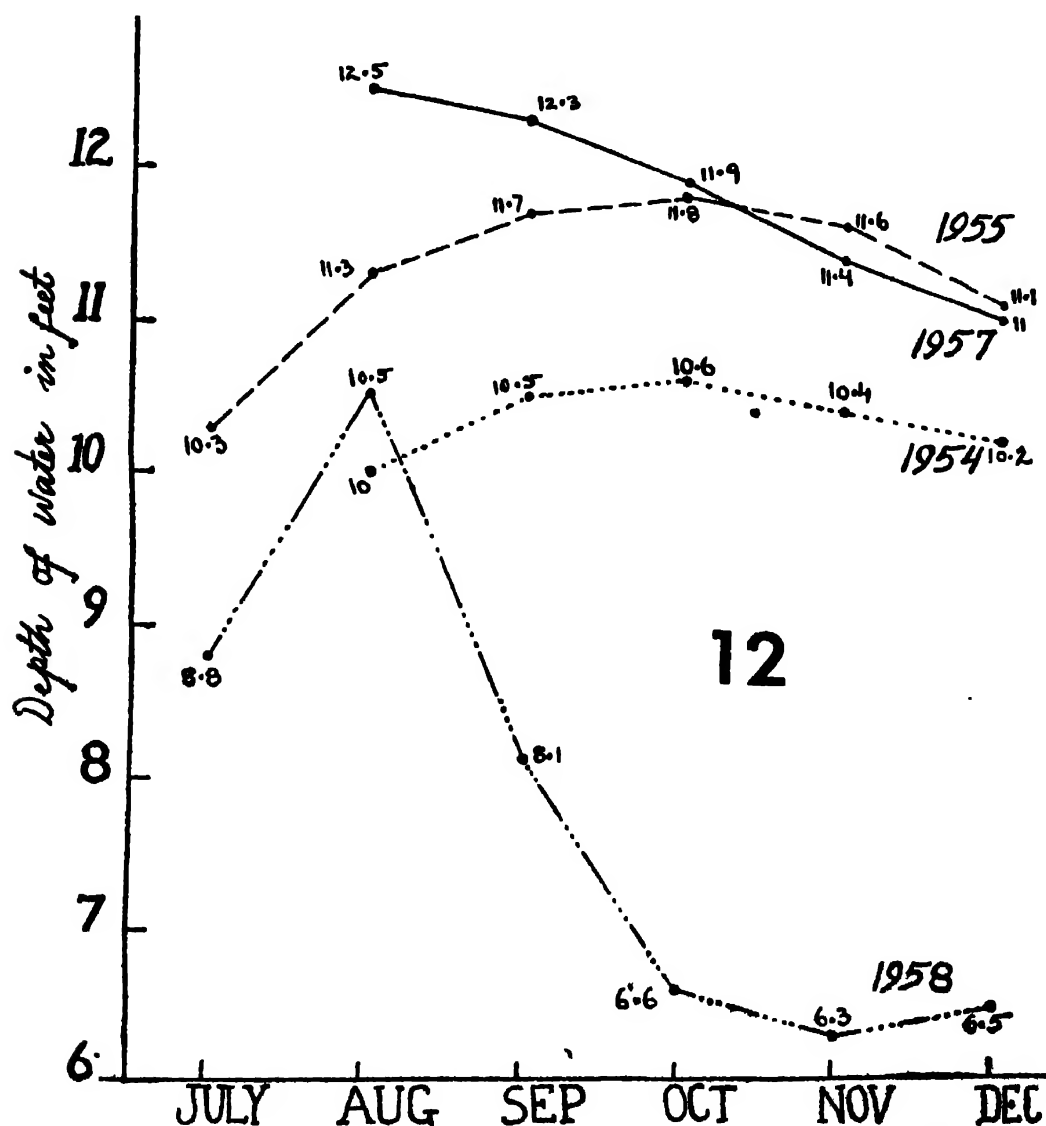


FIG. 12. Comparative depth of water in GL 34 during 1954-58 (data based on weekly observations, but monthly averages only considered for the graph). 1954-55 show a normal curve, 1956 data incomplete, 1957 data unreliable, 1958 water taken out.

However, it was unfortunate that a majority of the ponds in each village were subject to human interference and this caused sudden rise

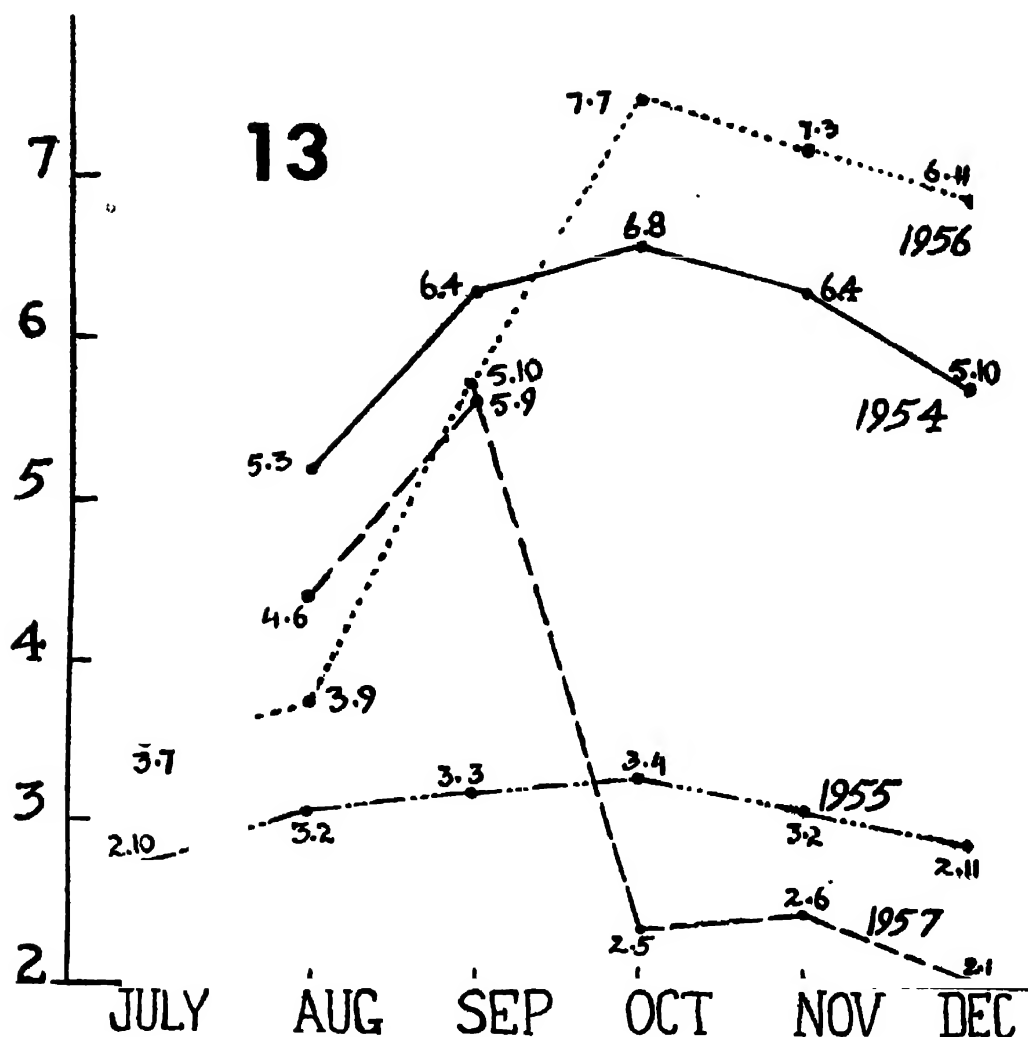


FIG. 13. Comparative depth of water in ML 13 during 1954-58 (data based on weekly observations, but monthly averages only considered for the graph). Data normal for 1954-55. 1956 floods, 1957-58 water withdrawn off and on.

or fall in depth of water, particularly during winter-spring cultivation periods when the ponds were either emptied or refilled with water.

It was interesting to observe that the relative growth of truly aquatic marginal flora followed a growth pattern similar to that shown by rise and fall in depth of water (Fig. 15), and this had a direct correlation with breeding of the *Anopheline philippinensis* mosquito.

PLANT ASSOCIATIONS AND CHANGES IN LOCAL POND FLORA

Previously (Kachroo, 1956) typical plant associations of the various zones of the ponds (based on water level and vegetation thereof) were discussed. To the various zones recognized therein, namely, flood, post-monsoon pool level, recession and continuous water zone, may now be added the *pre-monsoon* and *drought* pool-level zones. Much stress was laid (there) on the *continuous water zone* which was further subdivided into seven types: *flexuous*, *floating leaf*, *floating mat*, *carpet*, *submerged*, *pleuston* and *microscopic*—the latter classification was adopted in part after Hess and Hall (1945) and Penfound (1953). Of these seven types, the *flexuous*, *floating mat* and to some extent *submerged* are localized in the marginal.

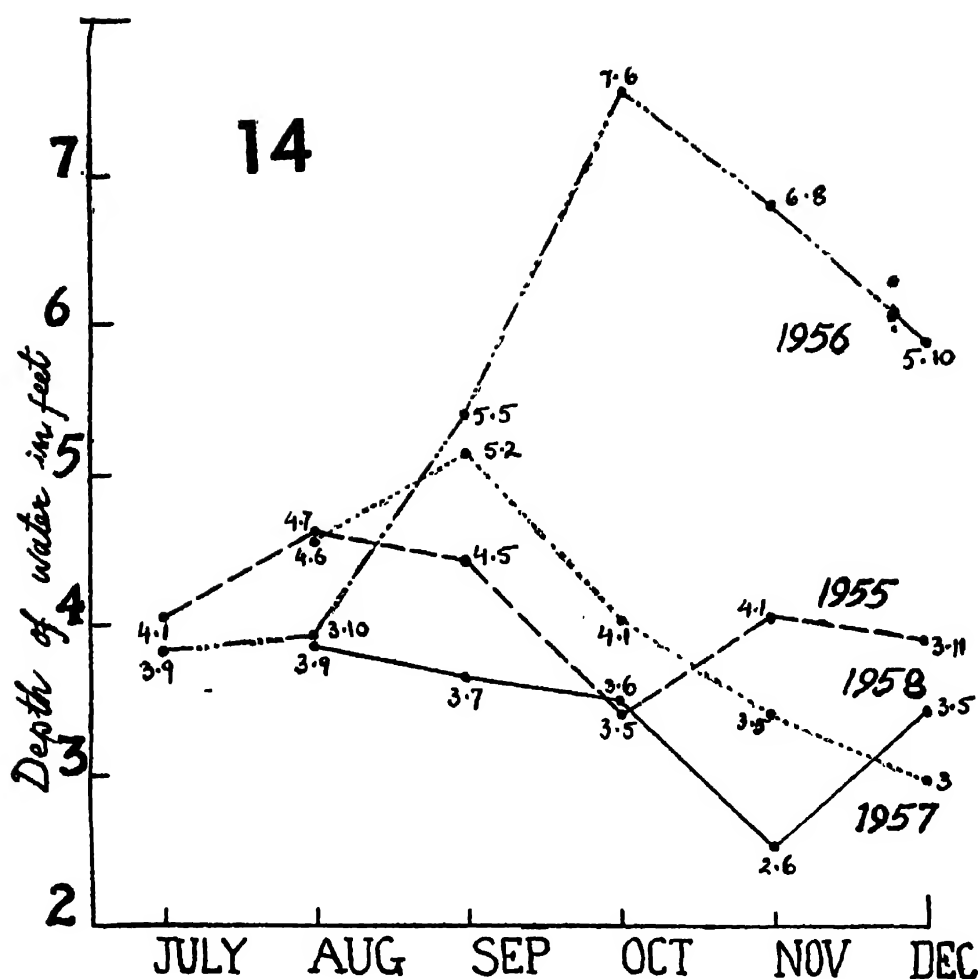


FIG. 14. Comparative depth of water in ML 14 during 1955-58 (data based on weekly observations, but monthly averages only considered for the graph). Data normal for 1957. 1955-56 floods, 1958 water introduced.

belt, and in the present investigation exclusive attention was paid to the representation of species in this belt: marginal.

In the ca. 20 ponds selected in District Burdwan (Fig. 1B) it was observed that normally this marginal belt (and often the central flora as well) was represented by a number of species, but rarely did the colonizing members represent the same species. Further, that in a number of cases the same associations were not characteristic of a pond each year but instead a definite species change occurred each year (in *sensu stricto*). Table 3 records a \pm constant floral (dominant) component for 1954-58 period.

A remarkable constancy appeared to have become the rule in these ponds, particularly with respect to the central flora, but minor floral elements did not remain constant for the whole period, e.g., in ML 1, the minor associates *Echinochloa colonum* and *Hydrilla verticillata* reached a stage of dominance during July-December, 1958. In ML 6 there was no trace of vegetation during the same period in 1958. *Pithophora oedogonia* flourished side by side with *Eichornia* in ML 9 during July-December, 1954, and disappeared in later years. In ML 19, though marginal flora remained constant, the central flora underwent distinct change (Table 3), and in GL 25 *Alternanthera sessilis* and *Utricularia flexuosa* did assume a status of dominance during 1956-57.

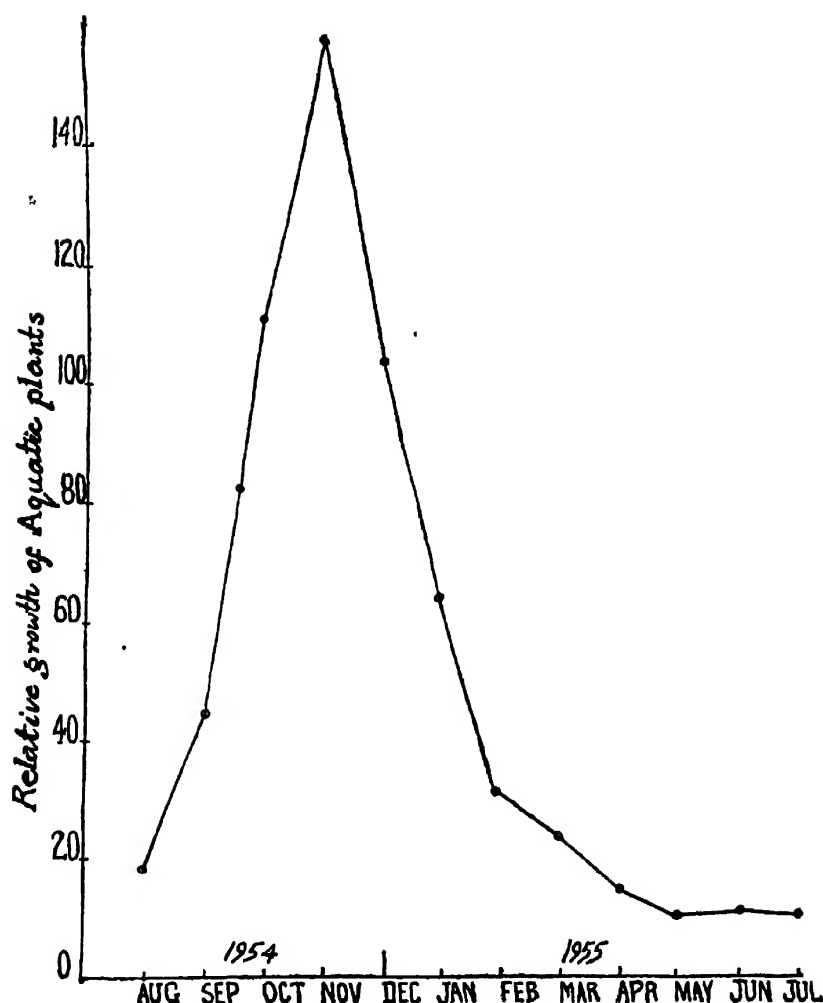


FIG. 15. Relative growth of aquatic plants for 1954-55 (based on Kachroo, 1956, Table IV).

The majority of ponds (Table 4) presented interesting changes in their floral set-ups and these (as will be discussed later) had a great bearing on their mosquito (mainly anopheline) breeding potential. These changes were brought about either due to their drying up, caused by marauding floods, or from human interference which consisted in removing all traces of flora during fishing operations, or emptying of a pond to fill up another pond near a cultivable field.

It is revealed from Table 4 that usually central flora (in these ponds) remained rather uniformly constant for the last five years, the notable exception being GL 31 where cleaning of the pond was responsible for extermination of *Nelumbo nucifera* and *Pistia* from the centre. In GL 44 similar causes were responsible for removal of *Nymphaea esculenta* from the scene and later its 'replacement' by *Azolla-Lemna* mat during 1957-58. ML 8, GL 34, Sanbhandapukur and Shibgere remained without central flora at one or other stage during this period, 1954-58.

The marginal flora appeared to be a casualty each time the ponds underwent a shake-up. Consequently in some ponds interesting 'succession' of plant associations was caused. These are discussed below:

In SHIBGERE during 1955 the marginal belt of flora was demarcated into two definite zones: (a) a thick flexuous association of *Commelina salicifolia*, *Ludwigia parviflora*, *Limnophila indica*, and (b) an erect-(naked)-leafy

TABLE 3

Dominant marginal and central floral components in some selected ponds, with insignificant yearly variations, for 1954-58 period

Pond/location	Dominant flora	
	Marginal	Central
ML 1/Krishanpur ..	<i>Eichornia speciosa</i> (in 1958 incl. <i>Echinochloa colonum</i> and <i>Hydrilla verticillata</i>)	<i>Eichornia</i> (<i>Lemna</i> and <i>Azolla</i> included in 1958)
ML 6/Krishanpur ..	<i>Pistia stratiotes</i> , no flora in 1958	<i>Pistia</i>
ML 9/Nandipur ..	<i>Eichornia speciosa</i> (+ <i>Pithophora</i> in 1954)	+ <i>Eichornia</i> (<i>Nymphaea lotus</i> * in 1956)
ML 19/Alipur ..	<i>Pistia stratiotes</i> (\pm often <i>Lemna</i>).	<i>Limnanthemum</i>....1955, <i>Pistia</i> ... (1955) 1956, Scum to nil....1957-58
ML 21/Alipur ..	<i>Hymenachne pseudointerrupta</i> (\pm <i>Marsilea</i>), in 1956 \pm absent	<i>Limnanthemum indicum</i> / <i>cristatum</i>
GL 25/Galsi ..	<i>Salvinia natans</i> , <i>Echinochloa colonum</i>	<i>Limnanthemum indicum</i>
GL 26/Galsi ..	<i>Panicum</i> spp. ..	As in above + <i>L. cristatum</i>
GL 34/Babla ..	<i>Scirpus articulatus</i> , <i>Spirogyra maxima</i> , <i>Marsilea quadri- foliata</i> (<i>Alternanthera ses- silis</i> , <i>Jussiaea repens</i>)	As in above
GL: Pakpukur/Kolkol	<i>Commelina salicifolia</i> , <i>Marsilea</i> , <i>Alternanthera</i> —data for 1955-56 only	<i>Hymenachne pseudo- interrupta</i> , <i>Pistia</i> (\pm <i>Nymphaea lotus</i> *)

* *Nymphaea lotus* is used for the white-flowered (local) *Nymphaea* throughout this paper.

association of *Polygonum hydropiper* and *Hymenachne pseudointerrupta*. At both places *Spirogyra* was common and profuse growth of *Cylindrospermum spirale* was recorded in zone a. The approach of winter brought with it a gradual recession in water level and consequent exposure of the marginal flora and finally its disappearance. *Pistia*, which comprised the central flora so far, now came to occupy the whole water surface and dominated throughout 1956. However, a few emergent grasses (mostly *Hymenachne pseudointerrupta*) and weeds (*Polygonum*, *Alternanthera*) colonized a meagre area here and there, but towards the close of 1957 the water level receded still further and the pond was practically without any trace of flora, till immediately after the rains when a few *Polygonums* and *Alternanthera* made their appearance in the recession zone. The pond remained contaminated with scum of *Microcystis aeruginosa* and *Chroococcus turgidus* for most part of 1958.

Disturbances caused by human interference were responsible for floral changes in ML 13. In 1954-55 *Pistia*, *Lemna*, *Panicum* and *Spirogyra* were

TABLE 4.

Annual variations in dominant marginal and central flora of some selected ponds for 1954-58 period in District Burdwan

Pond/locality	Dominant flora	
	Marginal	Central
Shibgere, Chotkhando	<i>Commelina salicifolia</i> , <i>Alternanthera</i> , <i>Ludwigia parviflora</i> , <i>Limnophila</i> <i>heterophylla</i> , 1955 <i>Pistia</i> , <i>Hymenachne pseudointerrupta</i> \pm <i>Polygonum glabrum</i> , 1956 Nil or \pm <i>Polygonum</i> , <i>Alternanthera</i> , <i>Hymenachne</i> , 1957 No flora (1957), 1958 ..	<i>Pistia stratiotes</i> No flora Nil or scum of <i>Microcystis</i> Nil or as above
ML 13, Chotkhando	<i>Pistia stratiotes</i> , <i>Lemna minor</i> , <i>Panicum myurus</i> , <i>Spirogyra maxima</i> , 1954-55 <i>Polygonum glabrum</i> , <i>Marsilea</i> , 1957- 58 (+ <i>Jussiaea repens</i> , <i>Hygrophorhiza</i> <i>aristata</i> and <i>Azolla</i> locally at a couple of places) <i>Alternanthera</i> , <i>Chara zeylanica</i> , 1954	<i>Limnanthemum indicum</i> / <i>cristatum</i> <i>Limnanthemum indicum</i> As above, + <i>Pistia</i>
Tentigere, Kolkol	<i>Salvinia cucullata</i> , <i>Spirogyra</i> + gras- ses, 1956 <i>Eragrostis</i> , 1957 .. \pm <i>Spirogyra</i> , \pm grasses, or absent, 1957-58	<i>Salvinia cucullata</i> <i>Pistia</i> <i>Azolla-Lemna</i> mat
GL 44, Kolkol	<i>Scirpus articulatus</i> , <i>Ceratophyllum</i> , <i>Jussiaea repens</i> , 1954-55 <i>Jussiaea repens</i> , <i>Cladophora glomerata</i> , grasses, 1956 <i>Azolla</i> , <i>Lemna</i> (\pm <i>Pistia</i>), <i>Ceratophyl-</i> <i>lum</i> , 1957-58 (+ <i>Jussiaea-Lemna-</i> <i>Ceratophyllum</i> for some months	(\pm <i>Nymphaea esculenta</i>) Nil (+ <i>Azolla-Lemna</i> mat)
ML 7, Nandipur	<i>Alternanthera</i> (\pm <i>Polygonum</i>), 1954- 55 <i>Spirogyra</i> , <i>Panicum</i> spp. (\pm <i>Pistia</i>), 1956-57 \pm <i>Echinochloa colonum</i> to absent, 1958	<i>Limnanthemum indicum</i> As above As above
ML 8, Nandipur	<i>Jussiaea repens</i> , <i>Spirogyra</i> , <i>Cassia</i> <i>tora</i> , 1955 <i>Polygonum orientale</i> , grass, 1956-57 <i>Alternanthera</i> (\pm <i>Polygonum</i>), 1958	Nil <i>Limnanthemum</i> in patches Nil

TABLE 4—contd.

Pond/locality	Dominant flora	
	Marginal	Central
Nukurpukur, Kolkol	<i>Cardanthera triflora</i> , 1955 .. <i>Salvinia natans</i> , <i>Pistia</i> , <i>Cyperus haspan</i> , 1956 No flora (after clearance <i>Najas foveolata</i> and marginal grasses), 1956-57	<i>Nelumbium speciosum</i> , 1-3 plants As above Nil
GL 45, Kolkol	<i>Hymenachne pseudointerrupta</i> , <i>Alternanthera</i> , 1955 <i>Pistia</i> (+ <i>Panicum</i>), 1956-58 (<i>Comelina</i> for few months in 1956)	<i>Nelumbo nucifera</i> and <i>Pistia</i> , 1955-57 Nil, 1957-58
ML 18, Chotkhando	<i>Enhydra fluctuans</i> , <i>Marsilea</i> , 1955 Grass + <i>Pistia</i> , <i>Lemna minor/polyrrhiza</i> , 1956 <i>Pistia</i> , <i>Marsilea</i> , 1957-58 ..	<i>Limnanthemum</i> + <i>Pistia</i> As above <i>Limnanthemum</i>
GL 27, Galsi	<i>Hymenachne pseudointerrupta</i> (+ <i>Monochoria hastaeifolia</i> in 1958; <i>Phormedium masses</i> in 1955), 1954-58. <i>Jussiaea</i> , <i>Marsilea</i> and <i>Panicum</i> in 1956.	<i>Limnanthemum indicum/cristatum</i> <i>Nymphaea lotus</i> , 1956
Shankipukur, Kolkol	<i>Jussiaea repens</i> , <i>Marsilea</i> , <i>Alternanthera</i> , 1955 <i>Hygrrrhiza aristata</i> , <i>Lemna minor</i> , 1956 <i>Aeschynomene aspera</i> , <i>Sphenoclea zeylanica</i> (in form of a 'forest'), 1958.	<i>Nelumbo nucifera</i> , <i>Limnanthemum indicum</i> As above <i>Nelumbium</i> , <i>Aeschynomene aspera</i>

dominant marginal species accompanied by turbid water. The minor elements were mainly represented by *Azolla pinnata*, *Utricularia stellaris*, *Aponogeton monostachyon*, *A. crispus*, *Sagittaria guayanensis*, *Monochoria hastaeifolia*, *Hygrrrhiza aristata*, *Jussiaea repens*, *Nymphaea lotus*, *Chara zeylanica*, *Polygonum hydropiper*, *Alternanthera sessilis*, *Ipomoea aquatica*, *Polygonum glabrum* and *Evolvulus nummularius*. During 1956 after the pond was cleared *Chara zeylanica* and *Alternanthera sessilis* assumed a dominant role, *Pistia-Lemna-Panicum* association having been exterminated! 1957-58 was marked by a dominant growth of *Polygonum glabrum* and *Marsilea quadrifoliata* in the earlier phases, and later mainly by *Marsilea* and *Panicum colonum*.

Plants like *Aponogeton* and *Sagittaria* due to their growth habits should

have grown again next season, but unfortunately the 1954 water level was never reached during the later years, 1955-58, and the areas occupied by these plants remained dry throughout.

The central flora represented by *Limnanthemum indicum* and *cristatum* remained constant throughout 1954-58 and was not affected even by cleaning of the pond. However, it was intimately associated with *Pistia* during 1956.

TENTIGERE showed dominance of *Salvinia cucullata*, *Spirogyra* and to some extent *Eragrostis* within the marginal belt during 1955-56, but this association was broken by floods which inundated this pond in late 1956. The floral elements were mainly *Commelina salicifolia*, *Panicum* spp., *Murdania vaginatum* and *M. malabaricum*. In 1957 the marginal belt remained practically denuded, except for grasses; while during 1958 *Spirogyra* also appeared for a few months.

The central flora of *Salvinia* persisted with traces of *Pistia*: the latter greatly increased its numbers after floods when it invaded from a near-by depressed land. Thus *Pistia* dominated during 1957 but was soon replaced by a mat of *Azolla* and *Lemna minor* which appeared rather constant during autumns of 1957-58.

Major changes in composition of marginal flora also occurred in GL 44. In 1954 there was observed a remarkable association of floating-mat (*Jussiaea repens*) and submerged species (*Ceratophyllum*) with over-all dominance of erect-naked *Scirpus articulatus* which was confined to one side of the pond. The minor elements were few but prominent, constituting *Marsilea*, *Hygrophorhiza aristata*, *Chara zeylanica* (*Hydrilla*, *Ipomoea aquatica*), *Azolla* and *Nymphaea lotus*. In early 1956 the pond was cleared and emptied. *Jussiaea* and grasses were the only representatives of marginal belt that grew again in early 1957; later *Azolla*, *Lemna* (\pm *Pistia*) and *Ceratophyllum* appeared and dominated throughout (Table 4).

In ponds with a meagre representation of marginal flora slight to prominent changes were also observed. Most of such ponds were with a \pm flat 'shore-line'. Prominent changes were observed in ML 7, ML 8, ML 18, *Nukurpukur* and GL 45 and rather slight variations in the rest (Table 4).

In some depressed-bottomed ponds (GL 46A) the decrease in water level caused gregarious growth of grasses and sedges to such an extent that the original flora was exterminated. This caused gradual choking up of this pond and later its recasting into a fresh pond!

SUMMARY

Vegetation of aquatic and marshy habitats is enumerated and discussed. Of the 237 plants collected in and around such habitats only ca. 27 were most commonly found and of these only 10 species dominated the local flora throughout the last five years. *Lemna*, *Azolla*, *Pistia*, *Nymphaea* and *Commelina* occurred in all types of situations, but *Enhydra fluctuans*, *Aponogeton monostachyon*, *Vallisneria spiralis* and *Myriophyllum* were normally restricted in distribution.

Usually species occurred in various mixed associations and in significant numbers in each pond, but uncommonly single or few individuals of plants represented the whole flora of a pond. Some plants showed great tendency towards formation of pure colonies or mats.

Depth of water (shallow or deep) and substratum (mud or mud-sand) had a definite bearing on composition of pond flora.

A majority of ponds were found simply to be permanent depressed lands, and their contour was determined by their bottom: depressed, \pm

flat, hoofprinted, semilunar, staired or cup-bottomed. Depressed and semilunar-bottomed ponds were best suited for a luxuriant marginal (aquatic) flora. The depth of water in each pond followed the same sequence *vis-à-vis* the monsoon.

Natural and human interference caused floral shake-ups, and in general the relative growth of truly aquatic plants followed a growth pattern similar to that shown by rise and fall in depth of water.

Marginal and central plant associations of about 22 selected ponds are discussed. Some of them showed \pm constant flora for the last 5 years, but a majority were subjected to vagaries of nature and human interference, and showed interesting floral 'succession', the latter in some cases resulting in extermination of previous dominant species or in introduction of a new element.

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APPENDIX I

List of aquatic and semi-aquatic plants of lower Damodar Valley

RANUNCULACEAE

Ranunculus sceleratus Lin.*

NYMPHAEACEAE

*Nymphaea*¹ 'lotus'.
 rubra Roxb.
 cyanea Roxb.
 esculenta Roxb.
 stellata Willd.
Nelumbo nucifera Gaertn.

CRUCIFERAE

Cochlearia flava Ham.

TAMARICACEAE

Tamarix troupis Hole.
 dioica Roxb.

ELATINACEAE

Bergia verticillata Willd.
 ammanioides Roxb.

MALVACEAE

Sida rhombifolia Lin.
 veronicaefolia Lamk.
Urena lobata Lin.

STERCULIACEAE

Pantapetes phoenicea Lin.

GERANIACEAE

Impatiens balsamina Lin.
Hydrocera triflora W. and Atts.

LEGUMINOSAE

Sesbania palludosa Prain.
 bispinosa (Jacq.) W. F. Wight.
Aeschynomene indica Lin.
 aspera Lin.
Neptunia oleracea Lour.
 (*Cassia tora* Lin.)
Desmodium gangeticum DC.
Smithia sensitiva Ait.

HALORAGACEAE²

Myriophyllum tuberculatum Roxb.
 indicum Willd.

LYTHRACEAE

Ammania peploides Spreng.
 pygmaea Kurz.
 pentandra Roxb.
 baccifera Roxb. Lin.
 multiflora

ONAGRACEAE

Jussiaea repens Lin.
 suffruticosa Lin.
Ludwigia parviflora Roxb.
Trapa natans Lin.
 bispinosa Roxb.
 maximowicksi Kors.

UMBELLIFERAE*

Oenanthe benghalensis Benth.
 stolonifera Wall.

RUBIACEAE

Oldenlandia paniculata Lin.
 corymbosa Lin.
 hynei HK f.
 diffusa Roxb.

COMPOSITAE

Caesulia axillaris Roxb.
Xanthium strumarium Lin.
Enhydra fluctuans Lour.
 calendulacea Less.*
Wedelia fluctuans Lour.
Conyzyga ambigua DC.
Eclipta prostrata (Lin.) Lin.
Emilia sonchifolia DC.
Mikania scandens Willd.
Tridax procumbens Lin.
Ageratum conyzoides Lin.
Gnaphalium indicum Lin.
 (*Centipeda minima* (Lin.) A. *Br. et
 Aschers)

CAMPANULACEAE

Lobelia alsinoides Lamk.
Sphenoclea zeylanica Gaertn.

CONVOLVULACEAE

Evolvulus nummularius Lin.
Merremia emarginata Halkier.
 hederacea (Burm. f.) Hall f.
Ipomoea aquatica Forsk.

* Not collected by the author, from Haines (1925).

¹ Species problem of Indian *Nymphaea* is a bit intriguing and needs critical study.² *Barringtonia acutangula* Gaertn. (Myrtaceae) is a general weed along river banks.

GENTIANACEAE

Limnanthemum cristatum Griseb.
indicum Thw.

HYDROPHYLLACEAE

Hydrolea zeylanica Vahl.

SCROPHULARIACEAE³

Bythophyton indicum Hook.
Centranthera humifusa Wall.
Lindernia cordifolia (Colsm.) Merr?
 anagallis Pennell
 crustacea (Lin.) F. Muell.
 hyssopioides (Lin.) Hains?
 angustifolia (Benth.) Wettst.
 parviflora (Roxb.) Haines
 pyxidaria Vahl.
Limnophila ciliata (Colsm.) Pennel
 conferta Benth.
 cordifolia (Colsm.) Merrill
 diffusa Benth.
 heterophylla Benth.
 indica (Lin.) Druce
Bacopia monnieri (Lin.) Pennel
Dopatrium junceum Ham.
 nudicaule Ham.
Bonnaya antipoda Druce
 veronicaefolia Spr.
Mazus japonicus (Thunb.) O. Kuntze

LENTIBULARIACEAE

Utricularia stellaris Lin.
 flexuosa Vahl.
 exoleta R. Br.
 racemosa Wall.
 bifida Lin.

ACANTHACEAE

Rungia parviflora Nees var. *pectinata*
Acanthus ilicifolius Lin.
Hygrophila polysperma T. And.
Asteracantha longifolia
Asystasia gangetica T. And.*
Cardaenthera triflora Ham.
Justicia procumbens Lin.
Staurogyne glutinosa O. Ktz.

VERBENACEAE*

Lippia nodiflora Rich.*
 geminata HBK.

AMARANTACEAE

Alternanthera sessilis Br.
Aerua lanata Juss.
 monsoniae Mart.

POLYGONACEAE

Polygonum orientale Lin.
 barbatum Lin.*
 serrulatum Lagasc.
 hydropiper Lin.
 flaccidum Meissn.
 tomentosum Willd.
 glabrum Willd.
Rumex maritimus Lin.

EUPHORBIACEAE

Securinega virosa (Roxb. ex Willd.) Pax
 and Hoffm.
Trewia nudiflora Lin.

CERATOPHYLLACEAE

Ceratophyllum demersum Lin.

HYDROCHARIDACEAE

Hydrilla verticillata Casp.
Lagarosiphon roxburghii Benth.
Vallisneria spiralis Lin.
Blyxa roxburghii Rich.*
Ottelia alismoides Pers.

SCITAMINAE*

Alpinia allughas Roscoe.

AMARYLLIDACEAE*

Crinum deflexum Ker.
 pratense Herb.

PONTEDERIACEAE

Monochoria hastaeifolia Presl.
 vaginalis Presl.
Eichornia speciosa Kunth.

XYRIDAE

Xyris pauciflora Willd.*

COMMELINACEAE

Commelina salicifolia Roxb.
 benghalensis Lin.
 (*attenuata* Koenig*)

Murdannia malabaricum (Lin.) Santapau
 vaginatum (Lin.) Buck.

JUNACEAE

Juncus prismatocarpus R. Br.*

TYPHACEAE

Typha angustata Chamb.

* Not collected by the author, from Haines (1925).

³ *Solanum sisymbriifolium* Lamk. is an occasional weed of river banks.

⁴ Current name, *Phyla nudiflora* (Lin.) Greene.

AROIDEAE

- Pistia stratiotes* Lin.
Cryptocoryne ciliata Bisch.
 spiralis Bisch.
 (*Lasia spinosa* (Lin.) Thw.)*

LEMNACEAE

- Lemna polyrrhiza* Lin.
 minor Lin.
 (*paucicostata* Hegelm.)†
 (*oligorhiza* Kurz.)†
Wolffia arrhiza Wimm.
 (*W. microscopica* Kurz.)†

ALISMACEAE

- Alisma plantago* Lin.
 reniforme Donn.
 oligococcum F. Muell.
Limnophyton obtusifolium Miq.*
Sagittaria sagittifolia Lin.
 guayanensis HBK.
Butomopsis lanceolata Kunth.

NAIADACEAE

- Aponogeton monostachyon* Lin.
 echinatum Roxb.
 crispum Thunb.
Potamogeton indicus Roxb.
 crispus Lin.
Najas foveolata A. Br.
 indica Lin.
 graminea BP.

ERIOCAELEAE

- Eriocaulon truncatum* Nees.
 sieboldianum Sieb. and Zucc.
 quinquaeangulare Lin.
 (*trilobum* Ham.)*

CYPERACEAE

- Cyperus cephalotes* Vahl.*
 cuspidatus HBK.
 flavidus Retz.
 difformis Lin.
 haspan Lin.
 iria Lin.
 procerus Rottb.
 distans Lin.
 nutans Vahl.*
 radiatus Vahl.*
 exaltatus Retz.
 compressus Lin.
 platyphyllus R.S.
 pumilus Lin.
Eleocharis plantaginea R. Br.
 fistulosa (Poir) Schult.
 capitata R. Br.

- Fimbristylis monostachya* Hassk.
 schoenoides Vahl.*
 (*squarrosa* Vahl.)*
 dichotoma Vahl.
 diphylla Vahl.
 aestivalis Vahl.
 tenera Roem and Schult.
 quinqueangularis Kunth.*
 complanata HS.
 argentea Vahl.
 miliacea Vahl.

- Kyllinga monocephala* Rott.
 (*Bulbostylis barbata* Kunth.)*

- Scirpus michelianus* Lin.*
 squarrosus Lin.
 grossus Lin. f.
 supinus Lin.
 erectus Poir.
 articulatus Lin.
 (*maritimus* Lin.)*

GRAMINEAE

- Chamaeraphis spinescens* R. Br.
Panicum antidotale Retz.
 proliferum Lamk.
 polystachya HBK.
 paludosum Roxb.
Leersia hexandra Sw.
Hygrophiza aristata Nees.
Saccharum spontaneum Lin.
Chionachne koenigii Thw.* (Spreng.)
Coix lachryma-jobi Lin.
 aquatica Roxb.*
Phragmites karka Trin.
Leptochloa filiformis R. and S.
 chinensis Nees.
Andropogon squarrosus Lin.
Brachiaria reptans (Lin.) C. A. Gardn. and
 C. E. Hubb.
 distachya (Lin.) Staff.
Chrysopogon aciculatus (Retz.) Trim.
Echinochloa colonum (Lin.) Link.
Eragrostis nutans (Retz.) Nees ex. Steud.
 elongata Jacq.
 uniloides Nees et Steud.
 tenella R. and X. var. *brevicaulis*
 Stapf. ex HK f.
 gangetica Steudel
 viscosa Trin.
Pseudographis minuta Pilgera.
Hymenachne amplexicaulis Nees.
 pseudointerrupta C. Muell.
Paspalidium punctatum A. Camus.
 geminatum (Forsk.) Stapf.
 flavidum (Retz.) A. Camus.
Pogonotherum spp.
Paspalum scrobiculatum Lin.
Setaria glauca Benth.
Sacciolepis interruptus Stapf.
 indica (Lin.) A. Chase.
Urochloa cymicina Kunth.
 panicoides P. Beauv.
Sporobolus tremulus Kunth.
Alloteropsis cymicina Stapf.

* Not collected by the author, from Haines (1925).

† May not deserve specific rank.

PARKERIACEAE

Azolla pinnata R. Br.*Ceratopteris thalictroides* (L.) Brongn.

SALVINIACEAE

MARSILEACEAE

Salvinia cucculata Roxb.
natans Hoffm.*Marsilea quadrifoliata* Lin.
minuta Lin.*

* Not collected by the author, from Haines (1925).

AQUATIC VEGETATION OF DAMODAR VALLEY

II. FURTHER OBSERVATIONS ON ASSOCIATION OF AQUATIC VEGETATION WITH ANOPHELINE BREEDING¹ WITHIN DAMODAR-EDEN CANAL AREA OF WEST BENGAL

By P. KACHROO²

(Communicated by Sri S. K. Saraswati)

INTRODUCTION

Prior to Sen (1941) a detailed study of the association of aquatic plants with anopheline mosquitoes did not seem to have attracted any attention in India. He (*loc. cit.* and 1954) discussed the role of these plants in ecology of a number of anopheline mosquito larvae. Recently Neogy and Kachroo (1956a) classified the aquatic vegetation of Damodar-Eden Canal area of West Bengal into a few broad plant types and gave relative importance of each type with anopheline breeding; and also bearing of plant cover on incidence of larvae in a few ponds. Kachroo (1956a) commented on some ecological aspects of aquatic plants and their intimate association with a number of algae; and also on association of *Oscillatoria* and *Anabaena* with anopheline breeding (Kachroo, 1956b). Later he (1960) discussed broadly the bearing of phytoplankton on nutrition of anopheline larvae.

The present investigation records further observations on the association and bearing of freshwater aquatic plants and algae on anopheline breeding in the same area as dealt with previously: Damodar-Eden Canal area of West Bengal (Fig. 1). The villages and ponds selected for this study and methods followed for collection and observation were the same as those enumerated and discussed previously (Neogy and Kachroo, 1956a).

However, care was taken to demarcate a suitable region in each pond with a pure community of an aquatic plant, or a plant type, for sampling throughout the observation period and less reliance was placed on larval collections from ponds with unstable flora. Care was also taken to minimize the effects of random sampling from different colonies of plants in a single pond or even from different ponds. In such pools, where breeding of *A. philippinensis* was particularly pronounced, observations were continued throughout the year to determine the frequency of breeding in pre- and post-monsoon mosquito breeding seasons; otherwise the collections were made mainly during July-December periods (each year)—the local malaria transmission season.

CLASSIFICATION OF PONDS IN RELATION TO ANOPHELINE BREEDING

An exhaustive account of the pond vegetation was included in Part I of this investigation (Kachroo, 1959) and was also partly discussed previously (Kachroo, 1956a). Table 1 shows the extent of association between

¹ In this paper attention is focused towards marginal flora of ponds as normally this only is associated with breeding of anopheline larvae. They were never collected in association with the flora in the middle of ponds!

² At present, Editor, Indian Council of Agricultural Research, New Delhi.

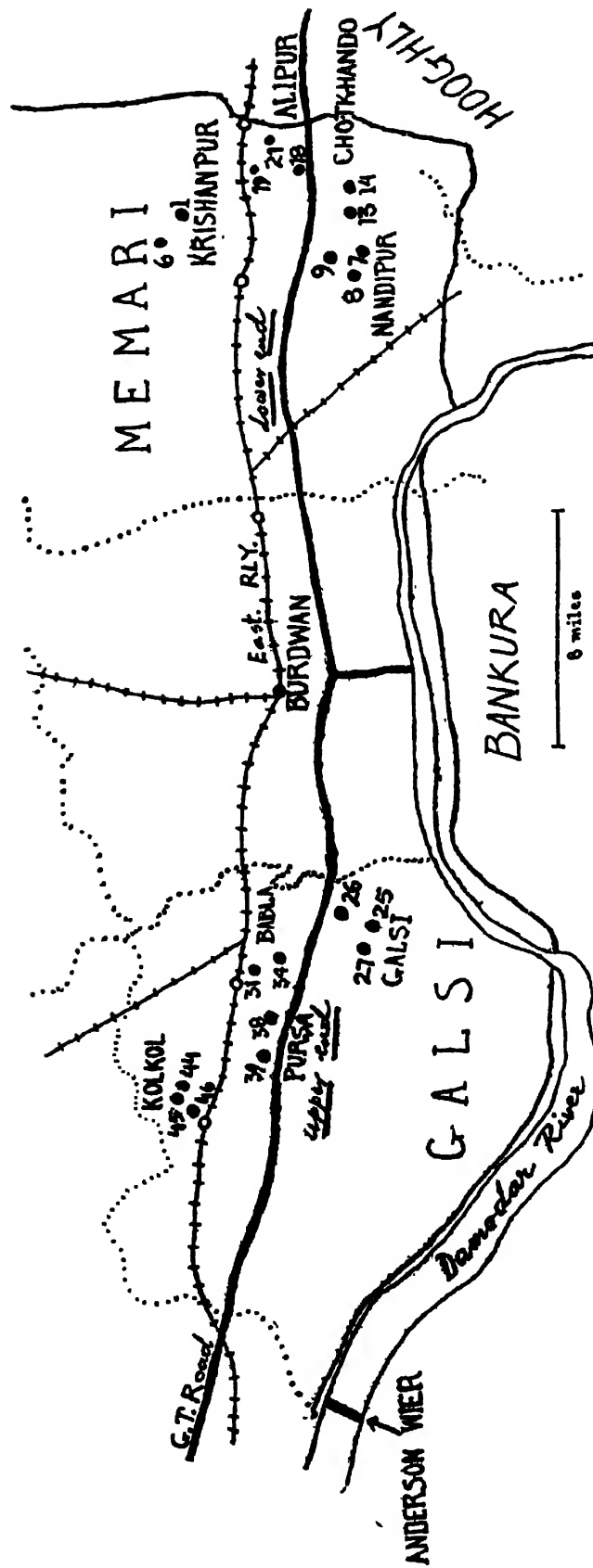


FIG. 1. Part of District Burdwan showing location of selected villages and ponds

TABLE I

Intimate and negative association between aquatic plants and anophelines in the Damodar-Eden Canal area of W. Bengal for 1954-58 period

Pond	Aquatic plant(s)	Associated anopheline spp.	
		Intimate	Negative
ML 7	<i>Eichornia speciosa</i>	hyrcanus, barbirostris	philippinensis, aconitus (pallidus)
	<i>Pistia stratiotes</i>	as above and subpictus	as above and (vagus)
	<i>Echinochloa colonum</i>	hyrcanus, barbirostris	vagus (aconitus, philippinensis)
	<i>Salvinia natans</i>	as above and subpictus	philippinensis, aconitus (varuna)
	<i>Limnanthemum indicum/cristatum</i>	as above (barbirostris)	philippinensis, vagus, varuna, aconitus (pallidus)
ML 8	<i>Hymenachne pseudointerrupta</i>	hyrcanus, barbirostris	philippinensis, ramsayi, varuna, aconitus
	<i>Alternanthera sessilis</i> , \pm <i>Polygonum</i> , 1954-55	hyrcanus	subpictus, ramsayi, philippinensis, vagus
	<i>Spirogyra</i> , <i>Panicum</i> (\pm <i>Pistia</i>), 1956-57 \pm <i>Panicum</i> to absent, 1958	hyrcanus, barbirostris, ramsayi	pallidus, philippinensis, aconitus
ML 13	<i>Jussiaea</i> , <i>Spirogyra</i> , <i>Cassia</i> , 1955	hyrcanus, subpictus	as above and varuna
	<i>Polygonum</i> , grass, 1956-57	hyrcanus, annularis	rest species exc. subpictus
	<i>Alternanthera</i> (\pm <i>Polygonum</i>), 1958	subpictus	pallidus, philippinensis, aconitus, varuna
ML 18	<i>Pistia</i> , <i>Lemna minor</i> , <i>Hymenachne</i> , <i>Spirogyra</i> , 1954-55	hyrcanus, pallidus	rest species
	<i>Alternanthera</i> , <i>Chara zeylanica</i> , 1956	hyrcanus	barbirostris, vagus
	<i>Polygonum glabrum</i> , <i>Marsilea</i> , <i>Echinochloa colonum</i> , 1957-58	hyrcanus, subpictus, annularis	rest species exc. barbirostris, subpictus
Shib-gere	<i>Enhydra fluctuans</i> , <i>Marsilea quadrifoliata</i> , 1955	hyrcanus, annularis, philippinensis	varuna, aconitus
	Grass, <i>Lemna minor</i> , 1956	hyrcanus, barbirostris	vagus, subpictus, varuna, aconitus
	<i>Pistia</i> , <i>Marsilea quadrifoliata</i> , 1957-58	hyrcanus, annularis	the rest species
Shib-gere	<i>Commelina salicifolia</i> , <i>Alternanthera sessilis</i> , <i>Lindernia parviflora</i> , <i>Limnophila heterophylla</i> , 1955	philippinensis	philippinensis, vagus, aconitus
	<i>Pistia</i> , <i>Hymenachne</i> , \pm <i>Polygonum</i> , 1956 Nil or \pm <i>Polygonum</i> , <i>Alternanthera</i> , <i>Hymenachne</i> , 1957	hyrcanus, ramsayi, barbirostris	nil
	No flora, 1957-58	hyrcanus, barbirostris, subpictus	annularis, vagus, varuna, aconitus
		hyrcanus, barbirostris	philippinensis, ramsayi, varuna, aconitus as above

TABLE 1—*concl'd.*

Pond	Aquatic plant(s)	Associated anopheline spp.	
		Intimate	Negative
GL 27	<i>Hymenachne</i> (— <i>Monochoria hastaeifolia</i> in 1958, <i>Phormedium</i> masses in 1955), 1955, 1957-58	<i>hyrcanus</i>	<i>pallidus</i> , <i>philippinensis</i> , <i>varuna</i> , <i>aconitus</i>
	<i>Jussiaea repens</i> , <i>Marsilea</i> , grass, 1956 ..	as above, ± <i>pallidus</i>	as above and <i>subpictus</i> , <i>ramsayi</i>
GL 31	<i>Echinochloa colonum</i> , <i>Hydrolea zeylanica</i> , 1954-58	<i>hyrcanus</i> , <i>subpictus</i>	<i>philippinensis</i> , <i>ramsayi</i> , <i>aconitus</i> , <i>varuna</i>
GL 34	<i>Scirpus articulatus</i> , <i>Jussiaea</i> , <i>Alternanthera sessilis</i> , <i>Spirogyra</i> , 1954-58 ..	<i>hyrcanus</i> , <i>annularis</i>	<i>philippinensis</i> , <i>ramsayi</i> , <i>varuna</i> , <i>aconitus</i>
GL 44	<i>Scirpus articulatus</i> , <i>Jussiaea repens</i> , <i>Ceratophyllum</i> , 1954-55	<i>hyrcanus</i>	<i>ramsayi</i> , <i>varuna</i> , <i>aconitus</i>
	<i>Jussiaea</i> , <i>Cladophora glomerata</i> , grass, 1956	<i>hyrcanus</i>	as above and <i>annularis</i> , <i>pallidus</i> , <i>subpictus</i> , <i>philippinensis</i>
GL 45	<i>Azolla pinnata</i> , <i>Lemna</i> (± <i>Pistia</i>), <i>Ceratophyllum</i> , 1957-58	<i>hyrcanus</i> , <i>annularis</i>	<i>varuna</i> , <i>aconitus</i>
	<i>Hymenachne</i> , <i>Alternanthera</i> , 1955 ..	<i>hyrcanus</i>	<i>annularis</i> , <i>ramsayi</i> , <i>barbirostris</i> , <i>vagus</i> , <i>aconitus</i> , <i>subpictus</i>
Tentigere	<i>Pistia</i> , <i>Hymenachne</i> , 1956-58 ..	<i>hyrcanus</i> , <i>subpictus</i>	<i>philippinensis</i> , <i>ramsayi</i> , <i>varuna</i> , <i>aconitus</i>
	<i>Salvinia cucullata</i> , <i>Spirogyra</i> , ± grass, 1956	<i>hyrcanus</i> , <i>philippinensis</i> , <i>barbirostris</i>	<i>ramsayi</i> , <i>vagus</i> , <i>aconitus</i>
	<i>Eragrostis</i> , 1957	<i>hyrcanus</i> , <i>annularis</i> , <i>philippinensis</i>	<i>barbirostris</i>
	± <i>Spirogyra</i> + <i>Eragrostis</i> , to absent, 1957-58	<i>hyrcanus</i>	all rest species

TABLE 2

Range of temperature ($^{\circ}\text{C}.$) and pH of water in selected ponds within Damodar-Eden Canal area for July-December periods: 1954 and 1957

	Memari thana (ML)										Galsi thana (GL)									
Ponds	1	6	7	8	9	13	14	18	19	21	26	27	31	34	38	39	44	45	46	
Temperature	26-33	22.5-24	22-30	24.4-32	23.5-32	28-30	25-32	24-30	22-30	23-32	22-23	22-29	23.5-25	21-32	21-31	24.5-33	25-33	21-32	26-32	
pH	6.5-7.5	6.1-6.5	6-6.9	6.5-6.7	6.5-7.5	6-6.5	6-6.2	6.1-6.5	6.1-6.4	6.1-6.7	6.3-6.5	6.3-7.1	6.8-7.5	6.5-6.8	6.8-7.5	7.1-7.2	6.8-7	6.3-7	6.8-7.5	
Temp. Max.	Aug.	Oct. ?	Oct.	Oct.	Oct.	Aug.	Aug.	Oct.	Aug.	Sept.	Sept.	Sept.	Sept.	Aug.	Sept.	Sept.	Nov.	Oct.	Nov.	
Min.	Dec.	Dec.	Dec.	Dec.	Dec.	Dec.	Nov.	—	Dec.	—	—	—	Dec.	—	Nov.	Nov.	Aug.	Dec.	Sept.	
pH Max.	Dec.	Oct.	Nov.	Sept.	Aug.	Dec.	Dec.	Sept.	Dec.	Oct.	Dec.	Sept.	Nov.	Oct.	Oct.	Oct.	Nov.	Oct.	Sept.	
Min.	Sept.	Dec.	Aug.	Dec.	Dec.	Dec.	Nov.	Dec.	Oct.	Dec.	Nov.	Dec.	Dec.	Nov.	Nov.	Dec.	Dec.	Nov.	Dec.	

aquatic plants or communities and anopheline larvae. These various associations and breeding potentials of the various ponds will be discussed presently.

pH or temperature (Table 2) did not prove reliable for a broad classification of the local ponds but it was felt that local 'succession' of the phanerogamic vegetation (in each pond) could be used for classifying them into a few broad types. Consequently they were divided into three \pm natural groups, namely: (a) ponds without flora; (b) those with a change in their floral composition; and (c) those with a \pm static flora for the entire season. This classification of the breeding pools provided an interesting study with respect to its bearing on the anopheline population of a particular pond. Each group is briefly dealt with below.

(a) POND^S WITHOUT FLORA were either (i) permanently devegetated; or (ii) temporarily devegetated.

(i) *Permanently devegetated ponds*.—Normally the banks of these ponds were without any trace of flora and the anopheline breeding was very meagre as compared to that in the near-by vegetated ponds (Fig. 2).

In GL 38 the most commonly collected anopheline larvae were those of *A. subpictus* and *A. hyrcanus*; in GL 39 the position was more or less the same except for inclusion of a sizeable number of *A. vagus* and *A. varuna*; in GL 46 and ML 14 \pm similar position prevailed (Table 3). However, the percentage of species not found was rather high, considering their breeding potential in the near-by ponds.

TABLE 3

Comparative anopheline breeding in ponds without flora: GL 38, 39, 46 and ML 14 during 1954-58

Pond/ locality	Anopheline larvae associated*		
	Commonly	Rarely	Never
GL 38 Pursha	<i>subpictus</i> , <i>hyrcanus</i>	<i>vagus</i> , <i>varuna</i> , <i>ramsayi</i> , <i>annularis</i> , <i>barbirostris</i>	<i>pallidus</i> , <i>aconitus</i> , <i>philippinensis</i>
GL 39 Pursha	<i>hyrcanus</i> , <i>subpictus</i>	<i>vagus</i> , <i>barbirostris</i>	as above, + <i>varuna</i> , <i>aconitus</i> , <i>ramsayi</i>
GL 46 Kolkol	as above and <i>barbirostris</i>	<i>vagus</i> , <i>annularis</i> , <i>pallidus</i>	<i>philippinensis</i> , <i>ramsayi</i> , <i>varuna</i> , <i>aconitus</i>
ML 14 Chotkhando	<i>hyrcanus</i> , <i>barbirostris</i> , <i>subpictus</i>	<i>vagus</i> , <i>annularis</i>	<i>pallidus</i> , <i>philippinensis</i> , <i>aconitus</i> , <i>varuna</i>

* The species are arranged according to their dominance in each group. The same arrangement is followed for the subsequent tables throughout this paper.

(ii) *Temporarily devegetated ponds*.—In a number of ponds with marginal flora, and often with an optimum breeding potential, the submerged banks were sometimes cleared or during the potato-cultivation they were nearly emptied in favour of those lying nearer the fields; thus

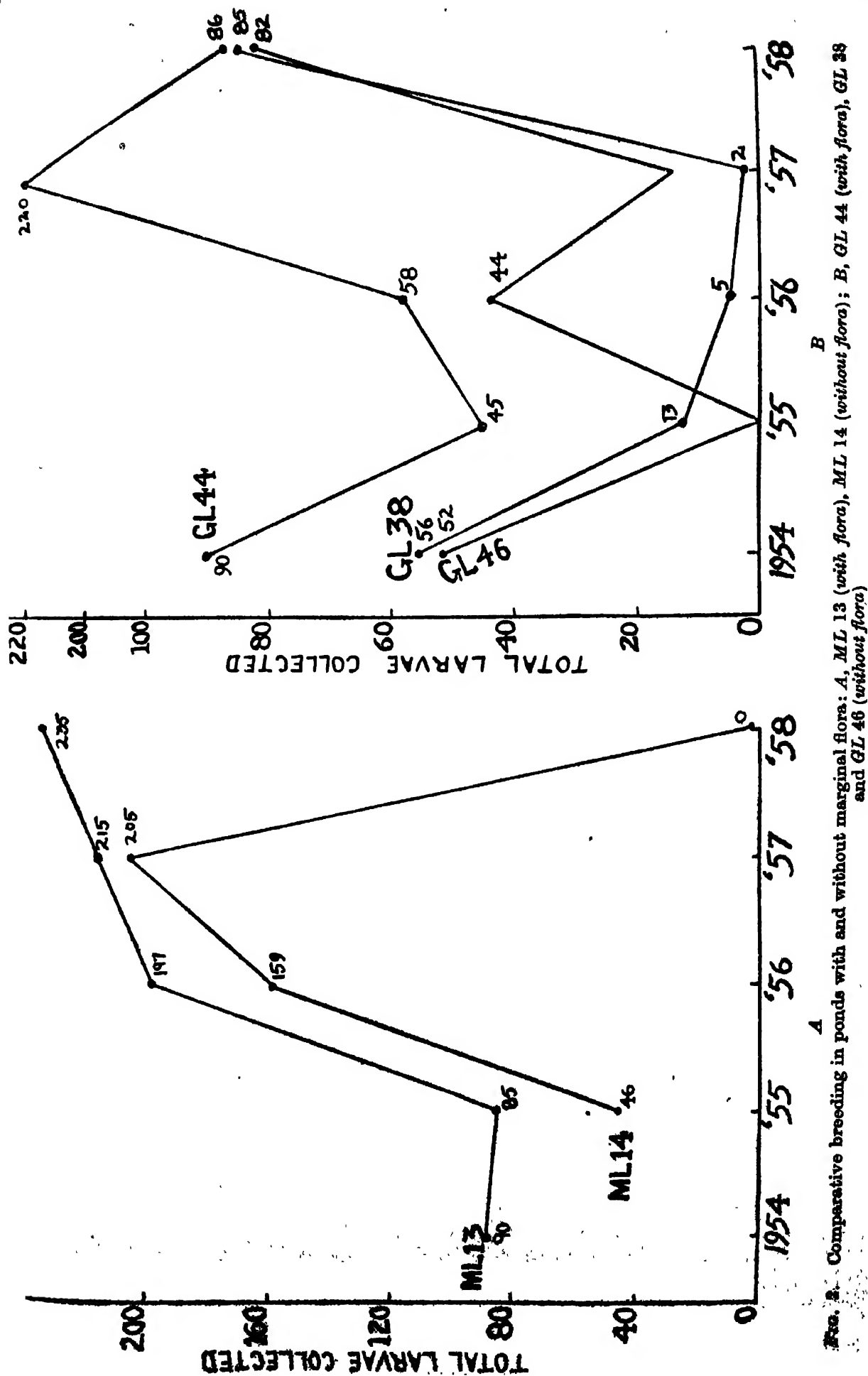


Fig. 2. Comparative breeding in ponds with and without marginal flora: A, ML 13 (with flora), ML 14 (without flora); B, GL 44 (with flora), GL 38 and GL 46 (without flora)

exposing the marginal belt of aquatic flora in the former and forcing the pond to assume a clear shore-line in the latter—in both cases the particular pond would lie without marginal vegetation. In clear-water ponds the species most affected as a result of devegetation was *Anopheline philippinensis*. Anopheline and floral changes in some ponds are summarized below.

Pond	Vegetation	Common anophelines	Rare anophelines
ML 6 Krishanpur	<i>Pistia stratiotes</i> : No flora:	<i>annularis</i> , <i>hyrcanus</i> , <i>varuna</i> nil	<i>barbirostris</i> <i>pallidus</i> , <i>ramsayi</i>
ML 19 Alipur	<i>Pistia stratiotes</i> : No flora:	<i>annularis</i> , <i>hyrcanus</i> nil	nil <i>subpictus</i> , <i>vagus</i>
Tentigere Kolkol	<i>Eragrostis</i> , <i>Commelina</i> , <i>Pistia</i> (<i>Spirogyra</i>): No flora:	<i>annularis</i> , <i>pallidus</i> , <i>ramsayi</i> , <i>hyrcanus</i> , <i>subpictus</i> nil	<i>vagus</i> <i>philippinensis</i> , <i>varuna</i> , <i>barbirostris</i>

(b) PONDS WITH A CHANGE IN THEIR FLORAL COMPOSITIONS.—The changes in floral compositions were either caused through human interference or naturally due to floods or drought. Both had a prominent bearing on composition and incidence of anopheline fauna. A few interesting cases are illustrated and discussed.

GL 44 (Kolkol): It is an exposed pond, with \pm steep banks and midway in size between a *pukur* and a *doba*. Except for a considerable period during 1956, when this pond was cleared, it remained vegetated throughout 1954–58 and had a fairly good breeding potential. *A. aconitus* and *A. culicifacies* larvae were never collected here. *A. ramsayi* was collected once during 1957; and *A. vagus* and *A. varuna* were rarely collected. Four different phases of vegetation were observed and associated larvae of each are outlined below.

Aquatic vegetation	Associated anophelines
I. <i>Scirpus articulatus</i> , <i>Ceratophyllum demersum</i> , <i>Jussiaea repens</i> , 1954–55	<i>hyrcanus</i> , <i>annularis</i> , <i>pallidus</i> , <i>barbirostris</i> , <i>subpictus</i> (<i>vagus</i> , <i>philippinensis</i>)
II. <i>Jussiaea</i> , <i>Cladophora glomerata</i> , 1956	<i>hyrcanus</i> (<i>varuna</i> , <i>barbirostris</i>)
III. <i>Jussiaea</i> , <i>Lemna minor</i> , <i>Ceratophyllum</i> , 1957	<i>hyrcanus</i> , <i>annularis</i> , <i>pallidus</i> , <i>philippinensis</i> , <i>subpictus</i> , <i>ramsayi</i> (<i>vagus</i> , <i>varuna</i>)
IV. <i>Azolla pinnata</i> , <i>Lemna</i> (\pm <i>Pistia</i>), <i>Ceratophyllum</i> , 1957–58	<i>hyrcanus</i> , <i>subpictus</i> , <i>annularis</i> , <i>pallidus</i>

TENTIGERE (Kolkol): It is rather a shaded *doba*, with distinctly steep banks. It underwent both natural and artificially created shift in its vegetation during 1956–58; and except for *A. culicifacies* nearly all local anophelines were collected from

this pond. It was the main *philippinensis*-breeding pool in Kolkol during 1956-57. The maximum breeding in this pond was that of *A. hyrcanus*. *A. varuna* and *A. aconitus* were rarely collected; *A. ramsayi* was collected only during 1957. Floral association with anophelines was as under for this period.

Salvinia cucullata, *Spirogyra maxima*,
Echinochloa spp., 1956
Eragrostis spp., 1957
± *Spirogyra*, grass to nil, 1957-58

hyrcanus, *philippinensis*, *barbirostris*,
annularis, *pallidus*, *subpictus*, *varuna*
as above, + *ramsayi*, *vagus*, *aconitus*
hyrcanus, *subpictus*, *vagus*

ML 13 (Chotkhando): It is a large, exposed pond with flat banks and in the immediate neighbourhood of a recently laid irrigation canal. It had had an ever present marginal flora. Breeding of *A. vagus* (1958), *A. varuna* and *A. aconitus* (1955) was very meagre and *A. ramsayi* appeared only during 1955 and 1957 (2 larvae only collected!). This pond was cleared in late 1955 and possibly again during 1957; this caused new floral associations and in later years created an optimum habitat for breeding of *A. philippinensis*. The 'succession' of anophelines was interesting as seen below:

Pistia, *Lemna minor*, *Panicum myurus*,
Spirogyra, 1954-55

hyrcanus, *pallidus*, *subpictus*, *annularis*,
ramsayi (*varuna*, *aconitus*, *philippinensis*)

Alternanthera, *Chara zeylanica*, 1956

Polygonum glabrum, *Marsilea*, *Echinochloa*
colonum, *Jussiaea repens*, *Hygrophorhiza*
aristata, 1957-58

hyrcanus, *barbirostris*, *pallidus*, *subpictus*
hyrcanus, *annularis*, *philippinensis*, *pallidus*,
subpictus, *barbirostris* (*ramsayi*,
vagus)

SHIBGERE (Chotkhando): It is a *doba*, ± shaded, with very steep banks and usually undisturbed. It had a very interesting floral history. The marginal belt represented a *flexuous* and an *erect-naked-leafy* flora—the two separated by 'open water'; the central region was full of *Pistia*. Natural recession caused a shift in floral elements till the stage came when no marginal flora could exist. *A. varuna* and *A. aconitus* did not breed here; the composition of other anophelines and associated flora was as follows:

Commelina salicifolia, *Alternanthera sessilis*,
Ludwigia parviflora, *Limnophila indica*,
1955

hyrcanus, *philippinensis*, *annularis*, *pallidus* (*aconitus*)

Pistia, *Hymenachne pseudointerrupta*, ±
Polygonum, 1956

hyrcanus, *ramsayi*, *barbirostris*, *pallidus*,
philippinensis (*subpictus*)

No flora, ± *Polygonum*, *Alternanthera*,
Hymenachne, 1957

subpictus, *hyrcanus*, *annularis*, *pallidus*
(*barbirostris*, *vagus*)

No flora, 1957-58

hyrcanus, *barbirostris*, *subpictus*, *annularis*, *vagus* (*pallidus*)

ML 7 (Nandipur) is one of the ponds which showed extreme instability in its flora; the causes for this being the often flooding of the pond and most inhospitable shore-line for the growth of a rich aquatic flora—the latter was indeed meagre and pocketed at a few places only. Except for *A. hyrcanus* and *A. barbirostris* the incidence of other species was very insignificant:

Alternanthera sessilis, *Polygonum orientale*,
1954-55

hyrcanus, *pallidus*, *annularis*, *varuna*,
aconitus (*barbirostris*)

Spirogyra spp., *Panicum*, ± *Pistia*, 1956-57

hyrcanus, *barbirostris*, *ramsayi*, *annularis*,
varuna (*vagus*)

Panicum to absent, 1958

hyrcanus, *subpictus*, *annularis* (*barbirostris*, *ramsayi*)

ML 18 (Chotkhando) represented a pond in which clearance caused disappearance of a dominant aquatic plant together with *A. philippinensis* which was intimately associated with it (*Enhydra fluctuans*). Its history is outlined below :

Enhydra fluctuans, Marsilea, 1955

hyrcanus, *annularis*, *philippinensis*, *ramsayi*, *pallidus* (*barbirostris*)

Grass, *Lemna* (after clearance), 1956

hyrcanus, *barbirostris*

Pistia, Marsilea, 1957-58

hyrcanus, *annularis*, *ramsayi*, *pallidus*, *subpictus*, *barbirostris*, *varuna*

(c) **PONDS WITH A \pm STATIC FLORA.**—Very few ponds retained the same floral elements throughout 1954–58 period. It was interesting to note that nearly all such cases showed a very high breeding potential for *A. hyrcanus*, *A. barbirostris* (and *A. subpictus*). *A. philippinensis* was invariably absent from such plant communities (Table 4). Fig. 3 summarizes data concerning association of a few more aquatic plants with some anophelines during July–December, 1955.

TABLE 4

Association of some aquatic plants from \pm static floral ponds with local anophelines for 1954–58

Pond/aquatic plants	Associated anophelines	
	Intimate	Rare
ML 1. <i>Eichornia speciosa</i>	<i>hyrcanus</i> , <i>barbirostris</i>	<i>pallidus</i> , <i>subpictus</i> , <i>varuna</i>
ML 6. <i>Pistia stratiotes</i>	as above + <i>subpictus</i> , <i>varuna</i>	<i>annularis</i> , <i>vagus</i> , <i>pallidus</i> , <i>ramsayi</i>
ML 21. <i>Echinochloa colonum</i>	<i>hyrcanus</i> , <i>barbirostris</i>	<i>subpictus</i> , <i>varuna</i> , <i>aconitus</i>
GL 25. <i>Salvinia natans</i>	as above + <i>subpictus</i> , <i>vagus</i>	<i>pallidus</i> , <i>varuna</i>
GL 26. <i>Hymenachne</i>	<i>hyrcanus</i> , <i>barbirostris</i>	<i>annularis</i> , <i>subpictus</i>
GL 34. Complex flora: <i>Alternanthera</i> , <i>Scirpus</i> , <i>Spirogyra</i> , <i>Jussiaea</i>	<i>hyrcanus</i> , <i>annularis</i> , <i>subpictus</i>	<i>annularis</i> , <i>subpictus</i> , <i>pallidus</i>

Effect of microclimatic influences created by variation in vegetation cover in the same pond on the nature of anopheline breeding :

Three cases are illustrated to bring the point home.

I. GL 45 (Kolkol): Variations in anophelines were observed from collections maintained at three 'stations'. At station *A* a luxuriant growth of *Jussiaea repens*, *Pistia stratiotes* and *Echinochloa colonum* was associated with *A. annularis*, *A. pallidus* and *A. ramsayi*; but at station *B* where *Pistia* was the only associate *A. annularis* and *A. pallidus* were only collected. In the region between these two stations *A. varuna* was the sole species that could be detected!

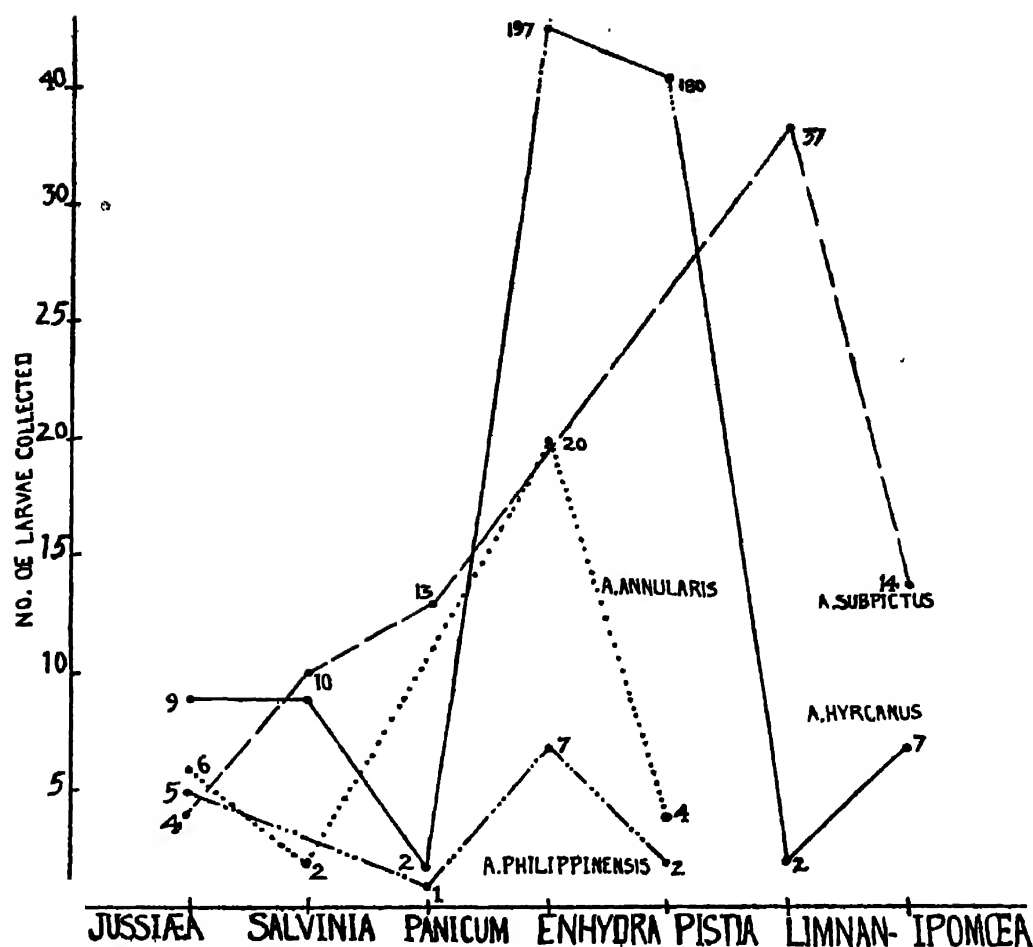


FIG. 3. Association of a few aquatic plants with *Anopheles subpictus*, *A. hyrcanus*, *A. annularis* and *A. philippinensis*

II. SHIBGERE (Chotkhando): In this pond collections were made from five selected stations (Fig. 4); associated anophelines at each place are summarized below:

- | | |
|--|--|
| (a) Erect-naked- <i>Pistia</i> assoc. | <i>annularis</i> , <i>philippinensis</i> , <i>hyrcanus</i> |
| (b) Flexuous assoc. | as above, + <i>pallidus</i> |
| (c) Erect-naked-leafy assoc. | <i>annularis</i> , <i>philippinensis</i> , <i>hyrcanus</i> |
| (d) <i>Pistia</i> alone | <i>hyrcanus</i> |
| (e) <i>Pistia</i> alone (another spot) | <i>hyrcanus</i> , <i>pallidus</i> |

III. Similar observations made from pond MENE (Fig. 5) are given below:

- | | |
|---|--|
| (a) Grass, <i>Marsilea</i> , <i>Limnanthemum</i> ,
<i>Azolla</i> , <i>Lemna</i> , <i>Nymphaea</i> assoc. | <i>hyrcanus</i> |
| (b) <i>Pistia</i> alone | <i>hyrcanus</i> |
| (c) <i>Ceratopteris</i> , <i>Marsilea</i> | nil |
| (d) <i>Chara zeylanica</i> alone | <i>annularis</i> , <i>hyrcanus</i> |
| (e) <i>Jussiaea repens</i> | <i>annularis</i> , <i>philippinensis</i> , <i>hyrcanus</i> |

ALGAL FLORA IN RELATION TO ANOPHELINE BREEDING

The phytoplankton,¹ as elsewhere, played a significant role in the local aquatic complex. The gases and chemical substances present in water

¹ Plankton is a term applied to small organisms which live, swim and drift in water and are not independent of the currents therein. (Yeastman, 1958. *J. Tennessee Acad. Sci.*, 31, 32).

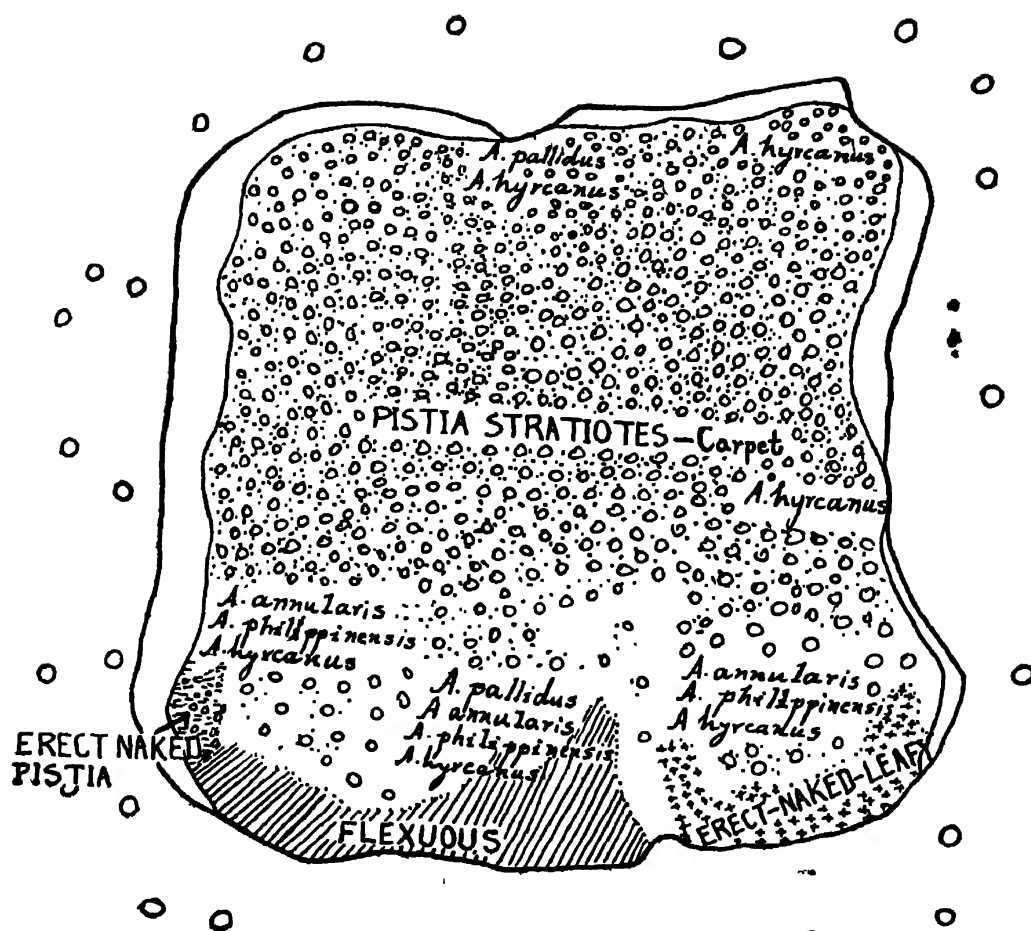


FIG. 4. Distribution of plants and anopheline larvae in pond SHIBGERE (Chot-khando) on 20th September, 1955

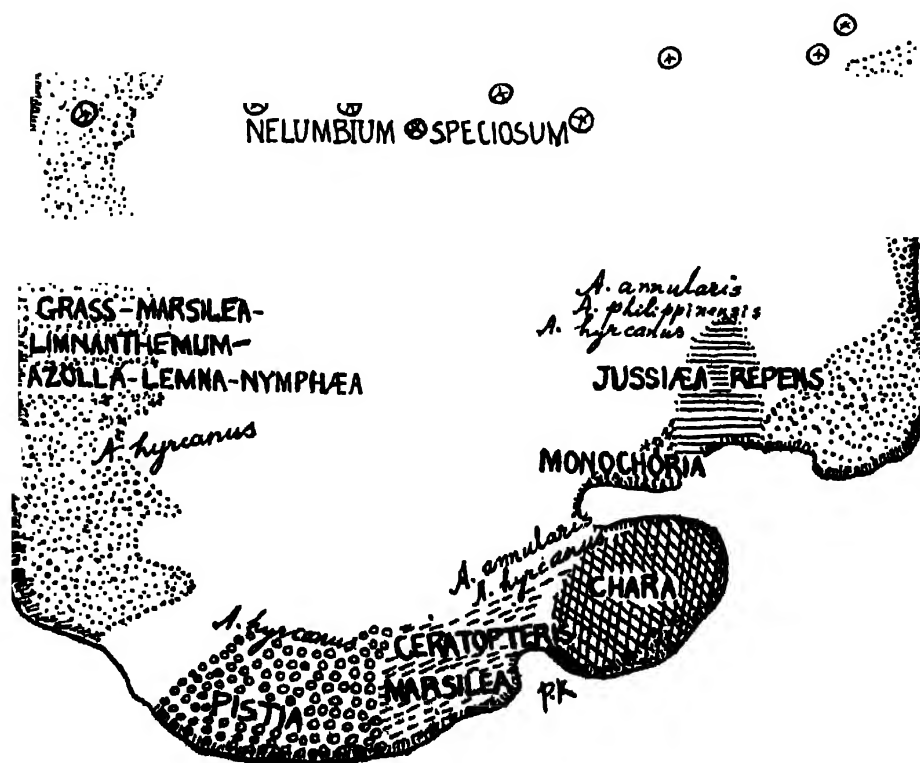


FIG. 5. Distribution of plants and anopheline larvae in a part of pond MENE (Chot-khando) on 20th September, 1955

affected their distribution and growth; and absence of certain genera of algae from some ponds was attributed to high temperature which involved a decrease in the amount of oxygen, thus causing difficulty in respiration.

The frequent changes in water level were found to cause changes in local algal flora and this indirectly affected mosquito breeding since the plankton are producers of food chains. Further, plankton were observed to undergo seasonal changes which are best explained as follows: (a) existence of species in extremely small numbers of individuals in active life; (b) existence of species in some quiescent stage; and (c) intervals between broods and generations (cf. Welch, 1952, p. 180).

Extensive collections of algae made during 1954-58 revealed preponderance of Chlorophyceae and Bacillariophyceae, but less so of other groups of algae. (A large number of diatoms and desmids could not be identified). A tentative distribution of algae within the whole lower valley is given below (Table 5); but the data presented here are subject to future exploration.

TABLE 5

*Taxonomic distribution of algae within the lower Damodar Valley
(mainly districts of Burdwan, Hooghly)*

Groups	Orders	Families	Genera	Species
Myxophyceae	3	6	15	45
Chlorophyceae	8	22	61	112
Xanthophyceae	1	2	3	3
Chrysophyceae	1	1	1	1
Bacillariophyceae	2	5	14	20
Cryptophyceae	1	1	1	1
Dinophyceae	1	1	3	5
Euglenineae	—	2	4	6

Majority of the algae recorded here (Appendix I) were found within the dissected guts of anopheline larvae—an obvious fact, since algae constitute more than 90 per cent of the total gut contents of larvae as will be seen from the following summary (see also Neogy and Kachroo, 1956c).

Green algae	95 p.c.
Blue-green algae	10-20 p.c.
Algal spores and cysts	10 p.c.
Leaf epidermis	0.25 p.c.
Animalcules	2.5 p.c.

The contribution of the various groups of algae towards food of anopheline larvae is given in Table 6.

It may be recalled here that the blue-green algae normally act as anti-larval agents (Purdy, 1920; Gerhardt, 1954; Neogy and Kachroo, 1956b; Kachroo, 1956a, b) and thus practically reduce the emergence of adults under field and laboratory conditions (Table 7).

Chara and *Nitella* were also reported previously to be antilarval but experimental evidences have pointed to the contrary (cf. Neogy and Kachroo, 1957). Recently Neogy and Kachroo (1957) proved conclusively that *Chara zeylanica* did not inhibit anopheline breeding; a conclusion based on study of breeding in: (a) artificial breeding pools each with *Chara zeylanica*, *Ottelia alismoides* and *Hydrilla verticillata*; (b) in natural ponds; and (c) by studying rate of emergence of *A. subpictus* and *A. philippinensis* over *Chara*-cultures.

TABLE 6
Relative contribution of algae towards nutrition of anopheline larvae, mostly based on analysis of larval gut contents (1954-58)

Family/group of algae	Parts eaten	Relative importance as food
Myxophyceae	Whole filaments, fragments, cells, hormogones	Low
Chlorophyceae		
Volvocales	Whole colonies or parts	Low
Chlorococcales	Unicellular forms, resting/reproductive stages	High
Ulotrichales	Whole filaments or parts	Very low
Cladophoraceae	Same	Low
Oedogoniales	Same	Very low
Conjugales	Same or unicellular forms	Very high
Characeae	Oogonia	Rare—trace
Xanthophyceae	Fragments	Same
Chrysophyceae	Whole cells	Very low
Bacillariophyceae	Same, colonies, spores	Very high
Dinophyceae	Whole cells	Very low
Eugleiniaceae	Same	Same

TABLE 7
Comparative effects of a few blue-green algae on the rate of emergence of some anophelines under laboratory conditions (based on Neogy and Kachroo, 1956)

Algae used	Anophelines	Emergence percentage	
		in blue-green algae	in other algae
<i>Anabaena flosaque</i>	<i>annularis</i>	0	30
	<i>subpictus</i>	0	20-60
	<i>philippinensis</i>	0	40-50
<i>Oscillatoria princeps</i>	<i>subpictus</i>	0-6	25-50
	<i>pallidus</i>	0	not recorded

ANOPHELINE BREEDING WITHIN DAMODAR-EDEN CANAL AREA

Of the various breeding habitats (Table 8), ponds with marginal vegetation provided an optimum breeding potential for nearly all species; significant exception being that of *A. culicifacies* which bred exclusively in pits along river- and canal-beds, or in river-bed itself. The selective breeding habitats (*exc. ponds*) of each anopheline is given below:

Anophelines	Vegetation (+)	Vegetation (—)
<i>annularis</i>	Paddy fields	Borrow pits
<i>barbirostris</i>	Fallow lands	Same
<i>hyrcanus</i>	Same, paddy fields	Same, drains, canals
<i>pallidus</i>	Paddy fields, depressed lands	Borrow pits
<i>ramsayi</i>	Paddy fields	—
<i>subpictus</i>	Paddy fields, fallow lands, swamps	Borrow pits, rain-water pools, drains
<i>vagus</i>	± Pools under bridge	As above <i>exc.</i> drains
<i>varuna</i>	Fallow lands	Fallow lands

TABLE 8

Number of breeding places and habitats of the local anophelines, 1954-58 period

Anophelines	Ground water pools															Total in per cent	
	Without macro-vegetation, micro-flora often present										With macro- and micro-flora						
	Exposed										Partly shaded	Exposed					
	Wells	River-bed	Pits/pools in river-bed	Canals	Pools along canals	Rain-water pools	Hoofprints	Drains	Borrow pits	Ponds (incl. <i>dobas</i> , <i>pukurs</i> , and tanks)		'Swamps'	Pools under bridge	Fallow lands	Paddy fields		Depressed lands
<i>aconitus</i>	0	0	0	1	0	0	0	0	68	19	—	—	4	—	—	0.1	
<i>annularis</i>	0	2	2	13	3	0	3	5	68	1,574	9	3	26	72	20	1.3	
<i>barbistrotis</i>	0	0	0	0	0	0	0	4	96	1,763	18	—	87	21	19	1.5	
<i>culicifacies</i>	0	10	37	15	13	0	13	0	15	14	—	1	0	1	1	0.08	
<i>hyrcanus</i>	0	0	0	59	0	0	0	103	157	3,359	14	—	63	59	14	2.8	
<i>pallidus</i>	0	0	0	7	0	1	0	1	22	1,137	2	—	6	16	13	0.88	
<i>philippinensis</i>	0	0	0	0	0	0	0	0	0	156	1	—	1	1	0	0.81	
<i>ramsayi</i>	0	0	0	2	0	0	0	0	17	356	—	1	31	54	5	0.34	
<i>subpictus</i>	0	29	0	28	51	119	51	76	232	2,092	39	—	43	50	13	2.01	
<i>vagus</i>	0	34	0	0	13	97	13	7	77	658	—	37	0	27	—	0.69	
<i>varuna</i>	0	0	0	1	0	0	0	0	1	176	—	—	.36	—	—	0.15	

A. philippinensis, *A. vagus* and *A. varuna* were never collected from canals. Breeding of *A. aconitus* was miserably low and *A. philippinensis* was exclusively restricted to ponds with marginal flora and clear water; it was further 'endemic' to two unirrigated villages. *A. hyrcanus* overshadowed all species in its breeding potential; however, in ground-water pools without vegetation, the most conspicuous species found was *A. subpictus*.

The total larval catches (1954-58) for the irrigated and the unirrigated areas did not show much variance (Table 9) but breeding in the 'lower end' was nearly double of that in the 'upper end' (Table 10). 1956 gave a

TABLE 9

Total larval catch (in numbers) from selected ponds for July-December periods: 1954-58

Pond	1954	1955	1956	1957	1958	Total
IRRIGATED AREAS						
Lower end						
ML 1	62	174	56	73	137	502
6	49	232	237	69	90	677
7	61	63	745	97	161	1,127
88	63	18	116	11	26	234
9	54	41	520	89	157	861
Upper end						
GL 25	201	51	210	44	143	649
26	106	36	238	29	108	517
27	—	40	127	70	20	257
31	142	119	72	41	156	530
34	165	nil	116	49	23	353
Total	903	774	2,437	572	1,021	5,707

UNIRRIGATED AREAS

Lower end						
ML 13	90	85	197	205	235	812
14	46	43	159	211	—	459
18	2	106	486	195	189	978
19	—	59	274	41	110	484
21	98	32	138	29	86	383
Upper end						
GL 38	54	13	5	2	85	159
39	36	80	80	18	2	216
44	90	45	58	218	86	493
45	—	83	138	59	158	438
46	52	nil	44	nil	82	178
Tentigere	—	—	67	275	105	447
Total	468	546	2,155	1,435	1,361	5,965
Grand total	1,371	1,320	4,592	2,007	2,382	11,672

TABLE 10

Comparative breeding of local anophelines in the upper and lower ends
(irrigated and unirrigated areas) for 1954-58 period

Anophelines	Upper end		Lower end	
	Irrigated	Unirrigated	Irrigated	Unirrigated
<i>aconitus</i>	2	1	3	5
<i>annularis</i>	195	105	483	199
<i>barbirostris</i>	101	121	211	479
<i>hyrcanus</i>	1,652	1,072	2,436	3,050
<i>pallidus</i>	29	82	6	108
<i>philippinensis</i>	—	117	1 ?	104
<i>ramsayi</i>	3	9	33	135
<i>subpictus</i>	282	308	134	253
<i>vagus</i>	46	75	9	59
<i>varuna</i>	3	20	79	24
Total	2,313	1,910	3,395	4,416

'bumper crop' in both the areas. However, 1957-58 showed a fairly increased catch from the unirrigated areas:

	1954	1955	1956	1957	1958	Total
Irrigated areas	903	774	2,437	572	1,021	5,707
Unirrigated areas	468	546	2,155	1,435	1,361	5,965

The individual species did not show a constancy in this respect (Table 10): *A. annularis* was more numerous in the irrigated areas, both in the upper and lower ends; but *A. pallidus*, *A. ramsayi* and *A. barbirostris* (and *vagus*) were more common in the unirrigated areas. *A. philippinensis* was confined to the unirrigated areas. In the lower end *A. hyrcanus* bred profusely in irrigated areas but in the upper end it dominated the unirrigated areas. *A. varuna* had a \pm similar story.

It was further observed that usually a number of anophelines were associated with each other in a pond: the association being either between two or three species. The most common and rare associations are given below. (The numbers within brackets denote times found together; the data is for 1954-58 period).

Most common associations

A. hyrcanus

+ *barbirostris*
+ *annularis*
+ *pallidus*

.. (46)
.. (37)
.. (12)

A. hyrcanus

+ *annularis* + *subpictus*
+ *barbirostris* + *varuna*

(9)
(9)

A. barbirostris + *hyrcanus* + *subpictus*
+ *hyrcanus* + *pallidus*

(8)
(8)

Rare associations: all (1)

A. annularis + *vagus* + *hyrcanus* *A. philippinensis* + *annularis* + *bar-*
+ *barbirostris* + *varuna* *birostris* + *subpictus* + *ramsayi*

A. aconitus + *hyrcanus* + *subpictus*
+ *hyrcanus* + *barbirostris*

However, it was not uncommon to collect species *alone* (see below); the notable exceptions being *A. aconitus*, *A. culicifacies*, *A. pallidus* and *A. philippinensis* which never occurred singly.

<i>A. annularis</i>	..	..	(4)	<i>A. ramsayi</i>	..	..	(1)
<i>barbirostris</i>	..	..	(7)	<i>subpictus</i>	..	..	(33)
<i>hyrcanus</i>	..	..	(95)	<i>vagus</i>	..	..	(2)
<i>varuna</i>	..	..	(1)				

TEMPERATURE AND pH TOLERANCE

The temperature (°C.) of (pond) water ranged from 22 to 23 during July-December period (1954, 1957); the usual variation in each pond was about $\pm 2^\circ$ each month. The maximum temperature in each pond was recorded during August-September (October) and minimum during December.

A vast majority of ponds were found alkaline in reaction, the pH ranging from 6 to 6.7. The period of maximum and minimum alkalinity rates varied in each pond and did not follow a regular curve as in the case of temperature. In rare instances the pH was 6.9-7.5 and the anopheline populations of such ponds are summarized below for 1954-58 period.

Pond GL 38 (Pursha), pH 6.8-7.5

1954	<i>subpictus</i> , <i>hyrcanus</i> , <i>varuna</i> (<i>annularis</i> , <i>barbirostris</i> , <i>culicifacies</i>)
1955	<i>subpictus</i> , <i>varuna</i> (<i>annularis</i> , <i>hyrcanus</i>)
1956	(<i>subpictus</i>)
1957	(<i>vagus</i> , <i>subpictus</i>)
1958	<i>subpictus</i> , <i>vagus</i> , <i>ramsayi</i> (<i>hyrcanus</i>)

Pond GL 39 (Pursha), pH 7.1-7.5

1954	<i>subpictus</i> , <i>vagus</i> (<i>annularis</i>)
1955	nil
1956	<i>subpictus</i> , <i>hyrcanus</i> (<i>vagus</i> , <i>barbirostris</i>)
1957	<i>subpictus</i> (<i>vagus</i>)
1958	nil (<i>subpictus</i>)

DISCUSSION

Aquatic plants as breeding associates.—Aquatic vegetation in normal breeding ponds was represented by two zones: marginal and central—of these the former only showed a definite correlation and bearing on anopheline breeding; the latter was never positive for anopheline larvae.

Of the various types of marginal vegetation discussed previously those kept under constant observation were: *flexuous*, *erect-naked-leafy* (*floating-mat*) and *carpet*. During 1954 it was seen that the largest number of larvae were associated with *floating-leaf* vegetation (Neogy and Kachroo, 1956a, p. 187) but in the latter years the *flexuous* type provided the most congenial and optimum breeding conditions nearly for all species; particularly for

A. annularis, *A. pallidus*, *A. philippinensis* and *A. ramsayi* (Table 11). However, during 1956 *A. philippinensis* reached peak development in association with a lax carpet of *Salvinia* associated with *Eragrostis* and *Spirogyra*—the next optimum being in *flexuous*! During July–December, 1955, breeding of *A. pallidus* reached a peak in association with loose *Pistia*-carpet; and that of *A. annularis* and *A. ramsayi* with floating-mat of *Enhydra fluctuans* (Fig. 6).

TABLE 11

Relative potential importance of various plant types in production of some local anophelines for 1955–57 period

Plant types	Anophelines: total larvae collected			
	<i>annularis</i>	<i>pallidus</i>	<i>philippinensis</i>	<i>ramsayi</i>
Flexuous	91	132	165	50
Erect-naked-leafy *	6	5	18	—
± Carpet	12	78	52	1
Floating-mat †	32	2	14	17

* Record for 1955. † Record for 1956.

The *flexuous* vegetation is a combination of emergent leafy and submerged plants with a considerable percentage of algae (both floating and epiphytic). It provided a maximum intersection value and an optimum condition for growth and development of anopheline larvae. It provided protection and shelter for the growing larvae and also a support for the freshly emerging adults. (Interested students are referred to Rozeboom and Hess (1944) for an elucidation of the *intersection line* and its values.)

The *erect-naked-leafy* type had the least intersection values and slight to nil association with algae or submerged flora. The *carpet*, when in pure state, did always eliminate breeding of species preferring clean water, a lot of oxygen, and plenty of algae due to its inhibitory action on aeration of water. The *floating-mat*, however, provided an optimum condition for breeding, since the great 'net' formed by the branches of the plants afforded maximum protection for the larvae as well as a congenial substratum for numerous unicellular and filamentous epiphytic algae.

A. philippinensis was never associated with a *single* plant. *A. annularis* was widely associated with plant associations and individual plants (Table 1). *A. pallidus* was only intimately associated with *Panicum*, *Pistia*, *Salvinia*, *Polygonum*, etc.; *A. ramsayi* with *Pistia* and grass; *A. hyrcanus*, *A. barbirostris* (and *A. subpictus*) with nearly all plants (cf. Table 1).

It was observed that very few ponds harboured exclusively single plants and that the nature of the marginal vegetation was much intricated as a number of plants were involved in their composition. Consequently it was thought undesirable to attribute associations to single plants (and sometimes to even colonies). Unfortunately Sen (1941), Senior White *et al.* (1943) and Iyengar (1944) recorded such associations with a number of anophelines.

Whereas absence of any association between a particular anopheline and a particular aquatic plant is not *always* an indication of its being an

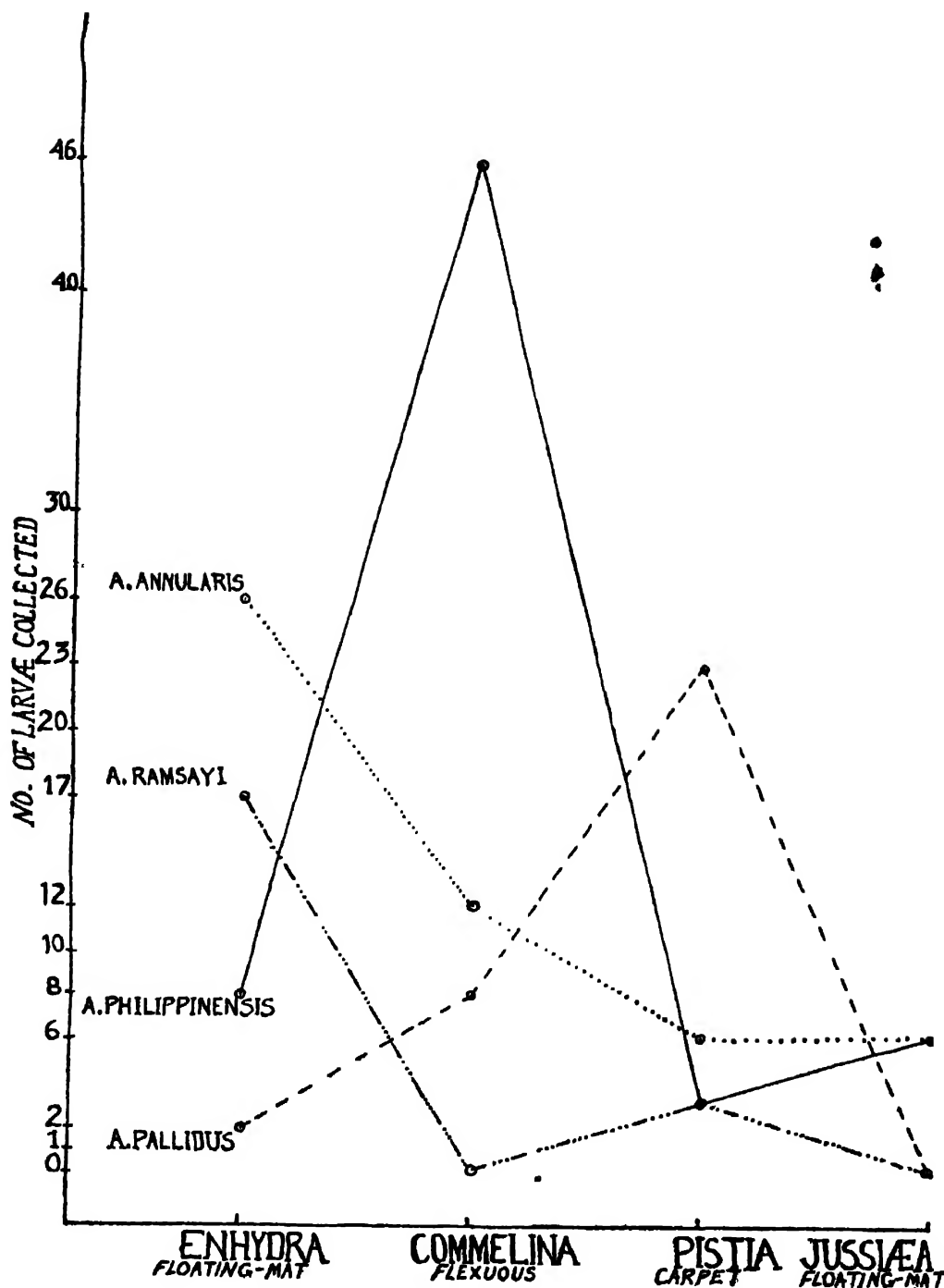


FIG. 6. Comparative breeding of *A. annularis*, *A. pallidus*, *A. philippinensis* and *A. ramsayi* in association with some common aquatic plants for July–December, 1955

antidote for breeding, it was observed that in a *limited sense* some plants were never associated with certain anophelines. Such non-associations were of two types: (a) inhibitory, and (b) seasonal; both are illustrated (Table 12).

However, certain blue-green algae like *Oscillatoria* and *Anabaena* inhibited the growth and development of anopheline larvae as previously also recorded by Iyengar (1944), Sen (1954) and Kachroo (1956).

Senior White *et al.* (1943) observed that in Orissa plants like *Lemna minor*, *L. polyrrhiza*, *Wolffia arrhiza* and *Eichornia speciosa* were unfavourable and even apparently inhibitory for breeding of *A. annularis*. Sen

TABLE 12
Non-association of local anophelines with certain aquatic plants

	Seasonal non-association				Never associated
	1958	1957	1956	1955	
<i>Eichornia speciosa</i>	<i>pallidus</i> , <i>varuna</i>	<i>annularis</i> , <i>pallidus</i> , <i>ramsayi</i> , <i>subpictus</i>	<i>annularis</i> , <i>subpictus</i>	as in 1956	<i>philippinensis</i> , <i>aconitus</i> , <i>vagus</i>
<i>Alternanthera sessilis</i> , — <i>Polygonum</i>	all exc. <i>subpictus</i>	all exc. <i>hyrcanus</i>	—	—	all spp. exc. <i>hyrcanus</i> , <i>subpictus</i>
<i>Limonanthemum</i> <i>indicum</i> , <i>Marsilea</i>	<i>varuna</i> , <i>barbirostris</i>	<i>pallidus</i> , <i>annularis</i> , <i>ramsayi</i>	—	—	<i>philippinensis</i> , <i>vagus</i> , <i>aconitus</i>
<i>Limonanthemum</i> , grass	<i>pallidus</i>	all exc. <i>annularis</i> , <i>hyrcanus</i>	<i>aconitus</i>	<i>pallidus</i> , <i>ramsayi</i>	<i>philippinensis</i> , <i>vagus</i> , <i>varuna</i>
<i>Lemna minor</i>	<i>barbirostris</i>	<i>ramsayi</i> , <i>vagus</i>	—	—	<i>philippinensis</i> , <i>pallidus</i> , <i>varuna</i>
<i>Salvinia natans</i>	<i>varuna</i> , <i>ramsayi</i>	<i>ramsayi</i> , <i>vagus</i> , <i>barbi-</i> <i>rostris</i> , <i>pallidus</i>	<i>annularis</i> , <i>varuna</i> , <i>ramsayi</i>	<i>varuna</i>	<i>philippinensis</i> , <i>aconitus</i>
<i>Hydrolea zeylanica</i>	<i>annularis</i>	<i>annularis</i> , <i>hyrcanus</i>	—	—	<i>pallidus</i> , <i>philippinensis</i> , <i>vagus</i> , <i>varuna</i> , <i>barbiros-</i> <i>tris</i> , <i>ramsayi</i> , <i>aconitus</i>
<i>Scirpus</i> , <i>Alternanthera</i> , <i>Justicia</i> , <i>Spirogyra</i>	all exc. <i>hyrcanus</i> , <i>subpictus</i>	as in above exc. <i>subpictus</i>	<i>pallidus</i>	—	<i>philippinensis</i> , <i>ramsayi</i> , <i>vagus</i>

(1941) observed that *A. philippinensis* was not associated with *Lemna*; *A. ramsayi* was mainly associated with *Pistia*, and *A. hyrcanus* was averse to *Ceratophyllum* and *Hydrilla*. Iyengar (1946) also noted *Eichornia* inhibiting development of *A. philippinensis* and *A. sundaicus*. Bose (1931) while commenting on association of *A. philippinensis* with vegetation remarked that he could attract or repel this species off from village tanks by introducing or removing suitable vegetation (cf. Krishnan, 1957, p. 23). Such an assertion does not seem to be supported by present observations since *A. philippinensis* was never associated with a single individual plant and factors other than vegetation complex of a breeding place may also have to be reckoned with. Besides it is observed that in Bengal there is not a single pond which could be said to be infested with a single plant community *ad hoc*.

Table 13 includes a comparison of data presented by Sen (1941) and the present author in regard to the association of some aquatic plants with breeding of anophelines in two \pm adjacent regions of West Bengal.

TABLE 13

Intimate association of a few aquatic plants with anopheline breeding, as based on Sen (1941) and the present investigation

Anophelines	Plants intimately associated	
	Lower Bengal (Madhyamgram) Sen (1941)	Damodar-Eden Canal Area Author
<i>annularis</i>	<i>Hydrilla</i> , <i>Ceratophyllum</i>	<i>Enhydra</i> , <i>Commelina</i> , <i>Alternanthera</i> , <i>Limnophila</i>
<i>pallidus</i>	<i>Utricularia</i> , <i>Ottelia</i> , <i>Najas</i>	<i>Pistia</i> , <i>Jussiaea</i> , as above
<i>philippinensis</i>	<i>Spirogyra</i> , <i>Utricularia</i> , <i>Limnanthemum</i> (and <i>Pistia</i>)	<i>Commelina</i> - <i>Alternanthera</i> - <i>Ludwigia</i> , <i>Enhydra</i> , <i>Jussiaea</i> , <i>Salvinia</i>
<i>ramsayi</i>	<i>Pistia</i>	<i>Pistia</i> , <i>Enhydra</i>
<i>hyrcanus</i>	<i>Pistia</i> , <i>Najas</i>	Nearly all local aquatics
<i>subpictus</i>	<i>Spirogyra</i> , <i>Lemna</i> , <i>Eichornia</i>	<i>Limnanthemum</i> , <i>Sesbania</i> , <i>Pistia</i> , <i>Salvinia</i> , etc.
<i>varuna</i>	<i>Eichornia</i> , <i>Najas</i> , <i>Ipomoea</i> , <i>Pistia</i>	<i>Pistia</i> (<i>Nymphaea</i>)

From a study of the above table it is apparent that *no single plant* is associated with breeding of *any one anopheline* in any area.

In conclusion a reference may be made here to breeding potential of paddy fields and fallow lands. When compared to that in ponds they represented a very minor element of the local anopheline fauna; however, they had a close affinity with that of borrow pits (Table 8). The most common species collected were: *A. annularis*, *A. ramsayi* and *A. subpictus*. A single larva of *A. philippinensis* was once collected from this habitat and it is feared that it had drifted from a near-by pond during flooding of the field. *A.*

varuna and *A. aconitus* were absent from the paddy fields and *A. vagus* from the fallow lands; the latter also did not provide congenial habitat for *A. pallidus* and *A. aconitus*.

SUMMARY

The local anopheline breeding ponds were grouped under three \pm natural groups: ponds without flora (temporarily or permanently); those with changeable flora (changes brought about naturally or through human agencies); and those with a static flora. Changes in the vegetational set-ups and the bearing of each change on anopheline breeding are discussed; such changes caused diversity in anopheline-representation of a pond. *Anopheline hyrcanus* and *A. subpictus* were the only species that normally bred in permanently devegetated ponds.

Ponds with marginal flora showed greater breeding potential; the central flora of a pond had nothing to do with breeding. Most of the anophelines preferred flexuous type of vegetation which provided maximum intersection values and optimum breeding conditions; the next favoured association was with floating mat and a lax carpet of *Salvinia*, grass and *Spirogyra*. *Anopheles philippinensis* was never associated with a single individual plant, *A. hyrcanus* was associated with practically all aquatic plants.

The growth and development of marginal flora seemed to be governed by fluctuations in pond-water level which indirectly affected incidence of breeding: floods and extreme drought resulted in a clear shore-line and thus practically in nil breeding.

Normally a number of anophelines were associated with each other and only rarely did they show a tendency to breed singly.

A. philippinensis was restricted to ponds with marginal flora and clear water; and *A. culicifacies* exclusively to river- and canal-bed. *A. aconitus* was very poorly represented in this area; *A. hyrcanus* was the most dominant species.

Blue-green algae were found to be inimical to breeding, but green algae provided the main food supply of the larvae. Nearly all species of algae collected were found within the guts of larvae.

ACKNOWLEDGEMENTS

Grateful thanks are due to Dr. B. P. Neogy for encouragement and facilities; to Prof. I. Banerji and Director, School of Tropical Medicine, Calcutta, for library facilities; to Dr. B. L. Wattal for a few comments; and to Dr. H. Santapau for going through this paper. Thanks are due to Messrs. K. Biswas and S. K. Dhar for laboratory assistance.

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APPENDIX I.

A list of algae collected from districts Burdwan and Hooghly

MYXOPHYCEAE

Chroococcaceae

- Microcystis aeruginosa* Kütz.
Gloeocapsa stegophila (Itz.) Rabenh.
Chroococcus turgidus (Kütz.) Näg.
C. minutus (Kütz.) Näg.
Merismopedia tenuissima Lemm. forma?
 Chamaesiphonaceae
Chamaesiphon siderophilus Starmach
 var. *glabra* Rao
C. siderophilus Starmach
 Stigonemataceae
Hapalosiphon welwitschii W. et W.
H. welwitschii forma
 Rivulariaceae
Calothrix fusca Born. et Flah. forma
Gloeotrichia raciborskii Wolosz. forma
 Nostocaceae
Cylindrospermum spirale Kg.
C. oryzae (mss. spp.)
Nostoc linckia (Roth.) Born. et Flah. forma
N. coeruleum Lyng. ex Born. et Flah.
Anabaena ambigua Rao forma
A. volzii Lemm.
A. gelatinicola Ghose forma
A. iyengari Bharadwaja (?)
A. sphaerica Born. et Flah. forma
 Oscillatoriaceae
Arthrospira platensis (Nordst.) Gomont.
 forma
Spirulina major Kütz.
Oscillatoria sancta (Kütz.) Gom. forma
O. tenuis Ag. forma
O. acuminata Gom. forma
O. limosa Ag.
O. princeps Vauch.
O. curviceps Ag. forma
O. martini Fremy forma
O. grunowiana Gomont. var. *articulata*
 (Gardner) Drouet.
O. amphibia Ag.
O. splendida Grev.
O. interrupta Mart.
O. minuta (mss. spp.)
Phormidium molle (Kütz.) Gomont.
Phormidium retzii (Ag.) Gom.
P. oryzetorum Mart.
Lyngbya dendrobia Bruhl et Biswas
L. solitarius Kg. ?
 Scytonemataceae
Scytonema cinnatum Thuret ex Born.
 et Flah.

CHLOROPHYCEAE

Chlamydomonadaceae

- Chlamydomonas braunii* Gor.
Eudorina elegans Ehrenb.
Gonium pectorale Muell.
Pandorina morum (Muell.) Bory
Volvox aureus Ehrenb.
 Sphaerellaceae
Sphaerella lacustris (Girod.) Witt.

Polyblepharidaceae

Dangeardinella spp. ?

Tetrasporaceae

Az

Chlorococcum humicolum (Näg.) Rabenh.

Chlorellaceae

Chlorella vulgaris Beyernick

Radiococcus spp.

Tetradon punctulatum (Reinsch) Hansg.

T. minimum (A. Braun) Hansg. forma

T. trigonum (Nagelli) Hansg. forma

Oocystaceae

Lagerheimia spp. ?

Nephrocystium spp.

Oocystis parva W. et W. forma

O. elliptica W. West ?

Selenastraceae

Ankistrodesmus falcatus (Corda) Ralf.

var. *acicularis* (Braun) W.

Kirchneriella contorta (Schmidle) Bohlin

K. lunaris (Kirchner) Moebius

Selenastrum gracile Reinsch. forma

Quadrigula closterioides (Bohlin) Printz ?

Dictyosphaeriaceae

Dictyosphaerium spp.

Dimorphococcus spp.

Hydrodictyaceae

Pediastrum simplex (Meyen) Lemmermann

P. boryanum (Turp.) Meneghini

P. duplex Meyen.

P. tetras (Ehrenb.) Ralf.

P. duplex var. *reticulatum* Lagerheim

Coelastraceae

Coelastrum sphaericum Näg.

Scenedesmus quadricauda (Turp.) de Bréb.

S. acuminatus (Lagh.) Chodat

S. obliquus (Turp.) Kuetzing.

S. abundans (Kirch.) Chodat

S. perforatus Lemmermann

S. bijuga (Turp.) Lagerheim

S. denticulatus Lagerheim

Tetradesmus spp.

Crucigenia tetrapedia (Kich.) W. et W.

C. rectangularis (A. Braun) Gray forma

C. quadrata Morren

Chlorosphaeraceae

Chlorosphaera alismatis Klebs.

Ulotrichaceae

Ulothrix pectinalis Kg.

Schizomeris spp.

Microsporaceae

Microspora spp.

Prasiolaceae

Prasiola spp.

Cladophoraceae

Cladophora glomerata (Lin.) Kütz.

C. (Aegagrophila) sauteri (Nees) Kütz.

Pithophora oedogonia (Mont.) Witt.

Chaetomorpha aurea Klotz.

Chaetophoraceae

Draparnaldiopsis indica Bharadwaja

Trentepohliaceae*Trentepohlia umbrina* (Kütz.) Born.*Phycopeltis epiphyton* Millard.*Coleochaete nitellarum* Jost.**Pleurococcaceae***Protococcus nigelli* (Cohdat) forma**Oedogoniaceae***Oedogonium gorakhporensis* R. N. Singh*O. decipiens* Witt.*O. armigerum* Hirn. forma *tenuis* Singh*O. sylvaticum* Hallas forma**Zygnemaceae***Spirogyra parvula* (Trans.) Czurda.*S. varians* (Kütz.) Czurda forma*S. longata* (Vauch) Czurda forma*S. neglecta* (Hass.) Kütz.*S. maxima* (Hass.) Wittr.*S. salsata* Kütz.*S. mirabilis* (Hass.) Kütz.*S. verruculosa* Jao. ?*S. nitida* Kg.*S. elongata* Kg.*S. spreana* Raben.*S. scrobiculata* (Stockmeyer) Czurda*Zygnema globosum* Czurda*Z. indica* var. *damodari* Kachroo**Mougeotiaceae***Mougeotia affinis* Kg.**Desmidiaceae** (a large number unidentified)*Penium polymorphum* Perty*Closterium monoliferum* (Bory) Ehrenb.*C. ralfsii* Breb.*C. parvulum* Näg.*Cosmarium granatum* Breb.*C. reniforme* (Ralfs.) Arch.*C. contractum* Kirch.*C. pseudopyramidatum* Lund.*Desmidium swartzii* Ag.*Euastrum inermis* (Norsd.) Turner*Gymnozyga monoliformis* Ehrenb.*Hyalotheca dissiliens* (Sw.) Breb.*Microsterias crux-meliiensis* (Ehrn.) Roy et Biswas*Onychonema filiformis* (Ehrenb.) Roy et Biswas*Sphaerosoma pulcherima* Sw.*Spondylosium ellipticum* West*Staurostrum deflectum* Breb.*S. apatinum* Cokke et Willis**Protosiphonaceae***Protosiphon botryoides* (Kütz.) Klebs.**Characeae***Chara zeylanica* Willd.*C. fragilis* Desv.*C. verticillata* Roxb.*C. foetida* A. Br.*Nitella flexilis* (L.) C. A. Agardh**XANTHOPHYCEAE****Tribonemaceae***Bumilleria klebsiana* Pascher*Tribonema bambycinum* (Ag.) Derbes et Sol.**Botrydiaceae***Botrydium granulatum* (Lin.) Grev.**CHRYSTOPHYCEAE****Ochromonadaceae***Ochromonas* spp.**BACILLARIOPHYCEAE** (majority unidentified)**Discoideae***Cyclotella comta* (Ehrenb.) Kütz.*Melosira* spp.**Fragilarioideae***Grammatophora maxima* Grwn.*Licmophora* spp.*Synedra ulna* (Nitz.) Ehrenb.**Naviculoideae***Cymbella cistula* (Hempr.) Grwn.*Frustulia* spp.*Gyrosigma* spp.*Navicula viridis* Kütz.*N. velox* Kg.*Pinnularia viridis* Ehrenb.*P. major* Kütz.*P. debessii* Hust.*Pleurosigma* spp.**Epithemioideae***Denticula* spp.**Nitzschioideae***Bacillaria paradoxa* Gmel.**CRYPTOPHYCEAE***Cryptomonas* spp.**DINOPHYCEAE***Glenodinium oculatum* Stein.*G. cinctum* Ehrenb.*Gymnodinium aeruginosum* Stein*Diclonium* spp.**EUGLENINEAE****Euglenaceae***Euglena viridis* Ehrenb.*Gymnastica elegans* Ehrenb.*Phacus pleuronectes* (Muell.) Duj.*P. hispudula* (Eichn.) Lemm.*P. acuminatus* Stokes**Peranemaceae***Peranema* spp.

VARIATIONS IN THE THIRD METATARSAL BONE OF MAN

By K. N. BHARGAVA and G. MALAVIYA

(Communicated by Professor N. K. Bose)

(Paper received on 22nd November, 1960)

INTRODUCTION

The third metatarsal bone forms the outermost component of the medial longitudinal arch of the foot, which is characterized by great curvature and remarkable elasticity.

The metatarsals and the metacarpals have been inadequately described in the different textbooks of anatomy, edited by Thane (1893), Frazer (1940), Wood Jones (1949), Brash (1951), Schaeffer (1953), Johnston *et al.* (1958) and Grant (1958).

Apart from textbook description there are very few original articles dealing with the description of the metatarsal bones. However, recently, Inderbir Singh (1959) described variations in the metacarpal bones of Indian Cadavers. He presumed that probably variations are peculiar to Indian Cadavers and as such have not been hitherto recorded by the authors of various British and American textbooks.

Wood Jones (1949) gave variations in the nutrient foramina of these bones. Schaeffer (1953) recorded few variations of these bones in Morris's *Human Anatomy*. Bhargava and Malaviya (1960a and b) gave an account of the variations seen in first and second metatarsal bones of the Indian Cadavers. But, as many deviations from the conventional textbook description were encountered in some specimens, a close study of the third metatarsal bone was thought desirable.

MATERIAL

One hundred third metatarsal bones, including 55 of the right and 45 of the left side, were studied from a collection of the dried and preserved bones in the Department of Anatomy and also from a collection of the Cadavers dissected during the current session. Variations observed in these bones have been noted and discussed.

OBSERVATIONS AND DISCUSSIONS

Variations were chiefly in respect of :—

1. The shape of basal articular surface for the lateral cuneiform bone.
2. The articular facets on the medial side of the base.
3. The articular facets on the lateral side of the base.
4. The site and number of nutrient foramina.
5. The surfaces and borders of the shaft.
6. The configuration of the head.

(1) *Variations in the basal articular surface for the lateral cuneiform bone*

The base is more or less triangular in appearance, but the shape and form of the triangle was much variable.

In a hundred metatarsals studied an indentation was almost always found to be present on the lateral side of the triangle except for five instances where it was absent. The medial side showed many variations, being almost straight in 45 cases, convex in 26 cases, indented in a manner similar to the lateral side in 14 cases and irregularly indented in the remaining 10 cases.



FIG. 1. Showing variations in the shape of the base of the third metatarsal bone.

A = Medial side of the triangle convex.

B = Medial side of the triangle almost straight.

C = A notch similar to that on the lateral side is present on the medial side of the triangle.

D = Medial side of the triangle is irregular.

E = Medial and the lateral sides of the triangular base are almost straight.

The contour of the basal facet also presented wide variations. It was uniformly concave in 53 cases, flat in 28 cases and convex from medial to lateral side in 19 cases.

(2) Variations on the medial side of the base

According to the usual textbook description, the medial side of the base of the third metatarsal articulates by two semioval facets, a dorsal and a plantar, with the second metatarsal bone. The two facets are interrupted by a rough anteroposterior groove giving attachment to the interosseous ligament. The two facets articulate with the anterior pair of facets on the lateral side of the base of the second metatarsal bone.

In our series, the plantar facet was absent in 29 cases, insignificant in 11 cases and present in 60 cases. The plantar facet was always smaller than the dorsal facet except in a singular instance where it was bigger than the dorsal one.

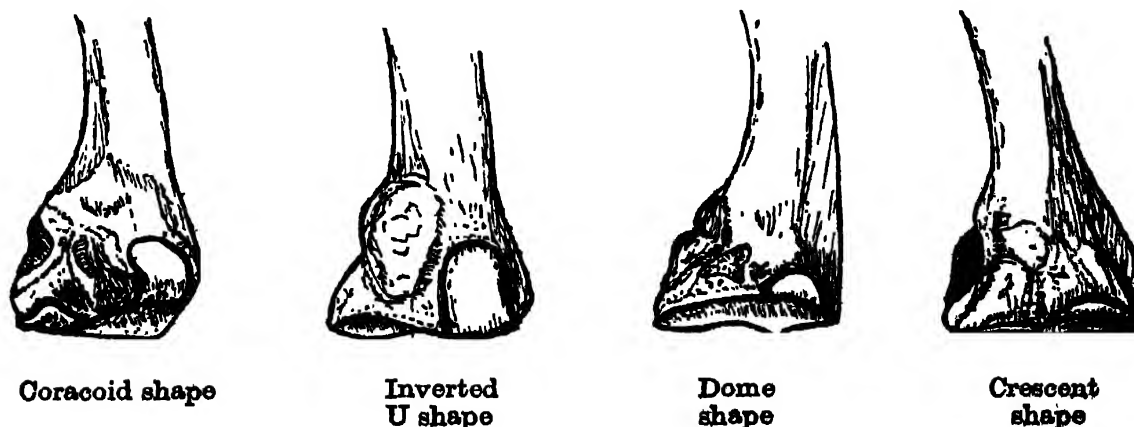


FIG. 2. Showing variations in the shape of the dorsal facet on the medial side of the third metatarsal bone (near the base).

The distal margin of the plantar facet was convex, resembling an arc of a circle in 32 specimens, conical in 12 specimens and rectangular with rounded corners in 16 cases.

The long axis of the plantar facet was placed vertically in 32 cases and horizontally in the remaining 28 cases.

The shape of the dorsal articular facet was also found to vary considerably. It was coracoid-shaped in 35, inverted U-shaped in 33, dome-shaped in 21 and crescent-shaped in 11 cases.

(3) Variations on the lateral side of the base

According to Johnston *et al.* (1958), as described in Gray's *Anatomy*, there is a single large oval facet situated on the dorsal angle of the lateral side of the base for articulation with the fourth metatarsal bone.

In the hundred metatarsals studied, beside the usual facet situated on the dorsal angle of the lateral side of the base, a ventral facet was also found in 23 specimens.

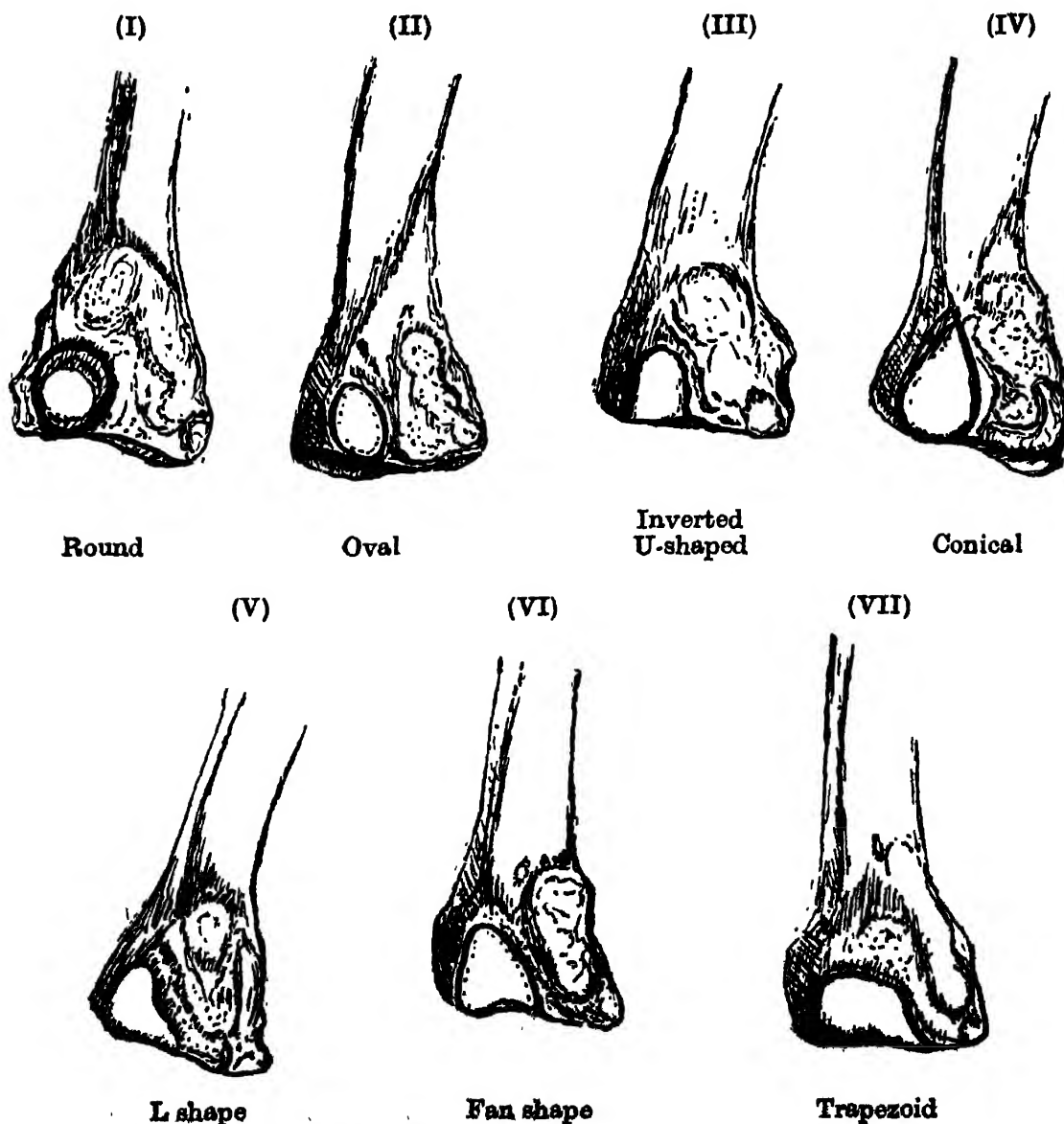


FIG. 3. Showing variations in

In 7 of these it was insignificant, but was quite marked in 16 cases. Out of these 16 specimens, the dorsal and ventral facets were continuous with each other through a prolongation of the ventral facet upwards in 9 specimens.

In the hundred third metatarsals studied, many variations in the shape of the dorsal facet were encountered. The dorsal facet was:—

(I) Round ..	in 18 cases.
(II) Oval ..	in 22 cases.
(III) Inverted U shape	in 27
(IV) Conical ..	in 15
(V) L shape ..	in 6 specimens.
(VI) Fan shape ..	in 9 bones.
(VII) Trapezoid ..	in 3 instances.

(4) *Variations in the site and number of nutrient foramina*

Wood Jones (1949) studied the variations in the site of nutrient foramina in a hundred third metatarsal bones and found that in 73 cases, the nutrient foramen was situated on the lateral side and in 27 cases it was on the medial aspect. The direction of the nutrient foramen is proximally towards the base of the third metatarsal.

In the present study of a hundred third metatarsal bones many deviations from the above description have been encountered. They are as follows:—

No nutrient foramen was observed in 18 cases.

A single nutrient foramen was present in 81 cases. In 51 of these cases it was present on the lateral surface, in 29 on the medial surface and in a solitary case on the dorsal aspect of the third metatarsal bone.

Two nutrient foramina were observed in only two cases where, besides the usual one situated on the lateral surface, an additional foramen was present on the medial aspect of the shaft of the third metatarsal.

The site of the nutrient foramina also presented considerable variations. In 43 specimens it was situated in the lower third of the shaft, in 38 specimens it was in the middle of the shaft and only in one bone it was observed in the upper third of the shaft. Beside, the nutrient foramina was considerably beyond the usual dimensions in 3 instances. In one case it was three mm. long and one mm. wide while in the remaining two cases it was nearly six mm. long and two mm. wide. In all these cases the nutrient foramen was situated in the lower third of the shaft on the medial aspect of the third metatarsal bone.

(5) *Variations in the surfaces and borders of the shaft*

According to Schaeffer (1953), 'the shaft is compressed side to side and presents three surfaces and three borders—a medial, a lateral and a plantar border'. The medial and lateral borders extend from either side of the tarsal end of the base to the phalangeal extremity terminating in tubercles thus demarcating the dorsal surface.

The dorsal surface provides origin to the adjacent dorsal interosseous muscles from the lateral and the medial side of the bone, leaving a portion of the dorsal surface free. But sometimes the origin of the two muscles encroaches on the dorsal surface completely and reduces it to a mere ridge in the middle of the shaft leaving a triangular portion free at the proximal and the distal ends.

(6) *Variations in the configuration of the head*

The head of the third metatarsal is flattened from side to side. It presents an articular surface on the dorsal aspect, which comes into contact with the proximal phalanx of the toes while walking.

This articular surface usually presents an area of uniform convexity directed towards the base of the metatarsal bone. In 57 specimens of the present study, a uniform convexity was noticed whereas in 43 cases there was a lipping of the articular surface on one side or the other. This lipping was much more frequent on the lateral side (41 cases) than on the medial side (only 2 cases).

SUMMARY

Variations in one hundred third metatarsal bones have been described and discussed. The variations were chiefly in:—

1. The shape of basal articular surface for the lateral cuneiform bone.
2. The articular facets on the medial side of the base.
3. The articular facets on the lateral side of the base.
4. The site and number of nutrient foramina.
5. The surfaces and borders of the shaft.
6. The configuration of the head.

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NOTE ON THE ORIYA PORTION OF THE VELIGĀLINĪ COPPER-
PLATE GRANT OF KAPILEŚVARA

By P. ACHARYA

(Paper received on 5th January, 1961)

Thanks are due to Dr. D. C. Sircar for the care and interest with which he edited the above-named copperplate grant¹ as it is an important document for the history of Orissa. Kapileśvaradeva or Kapilendradeva (as in the *Mādalāpāñjī*), the greatest king of Orissa, is described in the *Mādalāpāñjī* as a beggar boy and a thief. It is stated that it was through the grace of Lord Jagannātha of Purī that he was selected as the successor by the last Gaṅga king named Bhānudeva. But the discovery of contemporary records like the grants of Raghudeva,² the nephew and Viceroy of Kapileśvara, which have also been carefully edited by Dr. Sircar, has conclusively proved that Kapileśvara belonged to a respectable ruling family of the Solar Dynasty.

In his paper published in the *Journal of the Asiatic Society*, Vol. XXIII, Dr. Sircar wrote as follows: 'In these lines, I am placing before scholars my transcript and translation of this interesting document with the hope that improvements on them may be suggested by more competent students of Orissan epigraphy.'³ By expressing his views in the above manner, Dr. Sircar has shown his humility only. Dr. Sircar is not a scholar in Oriya and Telugu; but the manner in which he has edited this trilingual inscription, written in Telugu and Oriya scripts, deserves great credit. This very inscription was edited first by the late Raja Sahib Lakshminarayan Harichandan Jagadeva of Tekkali, who was a scholar in both Oriya and Telugu, in the *Journal of the Bombay Historical Society*, Vol. VI, pp. 94-111; but he failed to do any justice to this interesting document. Raja Sahib of Tekkali also published a paper in the Oriya monthly *Sahakāra*, Vol. XX, pp. 756-768, which included the text of the Oriya portion in December, 1939, and his transcript there is not at all intelligible. Dr. Kunjabihari Tripathi, M.A., Ph.D. (Lond.), has edited also this Oriya portion in the first issue of the *Konārka*, pp. 95-97, an Oriya quarterly which was published by *Orissa Sāhityā Academy* for September, 1958. Dr. Tripathi's reading is in no way helpful. We are fortunate that the inscription was re-edited by Dr. Sircar in the *Epigraphia Indica* and the *Journal of the Asiatic Society* for the benefit of scholars in general.

After going through Dr. Sircar's paper published in the *Journal of the Asiatic Society*, I found that improvement is possible both in regard to his transcript and translation as well as his interpretation. I therefore requested Dr. Sircar to send me a reprint of his paper on the 'Veligālinī Grant of Kapileśvara, Śaka 1380' published in the *Epigraphia Indica*, and I am very thankful to him for complying with my request.

¹ *Epigraphia Indica*, Vol. XXXIII, 1959-60, pp. 275-92; for a separate treatment of the Oriya portion see *Journal of the Asiatic Society*, Vol. XXIII, 1957, pp. 13-17.

² *E.I.*, Vol. XXXIII, 1959-60, pp. 1-32.

³ *J.A.S.*, Vol. XXIII, p. 13.

The grant was made on the occasion of the *Simha-Bṛihaspati-puṇya-kāḷa*. This occasion occurs every 12 years when Jupiter enters Leo and, during the period of one year when Jupiter remains in Leo, a bath in the river Godāvarī is considered most meritorious. Kapileśvaradeva, the king of Orissa, made the gift of lands in the form of *śāsanas* to Brāhmaṇas in order to commemorate himself, his father Jāgēśvaradeva and his mother Belamādevī on this auspicious occasion most probably at Rajahmundry in the river Godāvarī on the Vaiśākhī-pūrṇimā day. The astrological works called *Jyotirṇibandha* and *Nirṇayasindhu* discuss the significance of the *Simha-Bṛihaspati-yoga* in relation to the river Godāvarī. The *Jyotirṇibandha* quotes verses from the *Brahma Purāṇa*, *Brahmaṇḍa Purāṇa* and *Brahmavaivarta Purāṇa* and these Puranic references appear to be older than Śaka 1380. It seems that Dr. Sircar has missed this significance and therefore has translated this portion of the text as follows: '(while the king was taking bath for the purpose of making a grant) in the bed of the river Gautamī (i.e. Godāvarī) the Śrī-hasta (i.e. the king) poured water (i.e. made gift of the village Veligālini by pouring water in the hands of the donees) at a time when the *kāḷa* (i.e. *tithi*) was Pūrṇa (i.e. Pūrṇimā), (the week-day) Bṛihaspati (and the lagna) Simha.'¹

While dealing with the date of the grant given in the Sanskrit portion of the copperplate grant, Dr. Sircar has written as follows: 'The Sanskrit portion states that the grant was made by king Kapileśvara while he was camping on the bank of the Godāvarī on the occasion of the Vaiśākhī (i.e. the full-moon day of the lunar month of Vaiśākha) in the year 1380 of the Śaka era, otherwise styled Bahudhānya. The Vaiśākhī-pūrṇimā in Śaka 1380 = Bahudhānya began on Thursday, the 27th April, A.D. 1458, and ended next day. Normally therefore the date of the grant should be taken as the 28th April, A.D. 1458. But the Oriya part of the inscription edited here seems to give the name of the week-day on the said date as Bṛihaspati, i.e. Thursday. It is therefore possible that the grant was made on the 27th April, A.D. 1458.'² Elsewhere also he has written, 'The Oriya part of the inscription seems to supply the name of the week-day Bṛihaspati, i.e. Thursday.'³

From the above observation of mine, it will be clear that actually there is no mention of the week-day (Thursday) in the Oriya part of the inscription. The reference is to the planet Jupiter. The Vaiśākhī-pūrṇimā in Śaka 1380 fell on Thursday, the 27th April, A.D. 1458, and this is the date of the Veligālini copperplate grant.

The text of the inscription may be divided into three parts, *Part I* dealing with the locality and the occasion of the grant, *Part II* with the donees and *Part III* with the conditions of the grant.

My transcript of the Oriya text is given below. The corrections have been shown within brackets.

TEXT

Obverse

1. Meḍura-thala-madhye Belagālini-kāhākara-⁴nāmā-khaṇḍe āti-

¹ J.A.S., Vol. XXIII, p. 17. ² Ibid., pp. 13-14. ³ E.I., Vol. XXXIII, p. 277.

⁴ Dr. Sircar reads the word as *koshā-karaṇa*. There is no *o* sign with *kā* which is clear. The letter after *kā* is of peculiar shape. It looks like *ka* (cf. *hā* in *mahārājā* at the end of line 6). If it is a conjunct it may be *māha*. The fourth letter is of peculiar shape and I read it as *ra*. Thus Dr. Sircar's *koshā-karaṇa* stands for *kāhākara* or *kāmbhākara* according to my reading. It is a Telugu place name which has been used in Oriya.

2. to(thye)-bhogyama-Daṇḍapāṭa-mūla-koṭha-deśa(śa)ru phedi Śrīhasta¹
3. santake Gau(Gau)tāmī-nadi(dī)-garabha(garbha)-nirē Singha-
(Simha)-Bre(Bṛi)haspati-punya²(punya)-
4. kāli(kāla)-smae(samaye) Śrī-haste pāṇi(pāṇi) chhāḍilā-bhumī(mi)-
dāṇa-nānā-gotra-Brā-
5. mha(hma)ṇaṅku (|*) Bi(VI)ra-Śrī-gajapati(pati) Gau(Gau)de-
sa(śva)ra ṇa(na)ba(va)-koṭi-Karṇāṭa-
6. Kaḷabarage(varge)sa(śva)ra-Pratāpakapi(pi)ḷesa(śva)ra-
deba(va)-mā(ma)hārājā-
7. ṇikara data(tta) Jagesa(śva)rapura-sā(śā)sana-Belamapura-
sa(śā)sana-Pratāpa-Ka-
8. pī(pi)ḷesa(śva)rapura-sā(śā)sana (|*) E tini sā(śā)sanaku
bhā 40 lekhāe bhāga 120 madhye³
9. Bāḍi-tolā⁴(ṭā)-jaḷabhumī(mi) madha(dhya) kari dei-hoilā (|*)
E gā(gāṇ)ara bhumī
10. gā(gāṇ)a aimbhe(āmbhe) sarva māinya(mānya) chhatisa(śa)
ābadāna(avadāna) madha(dhya)kari chhāḍilāke bho-

Reverse

11. ga karāibā (||*)

TRANSLATION

Beligālini-kāhākara-khaṇḍa (or Kāmbhākara-khaṇḍa) situated in the holy place of Meḍura and allotted for the hospitality and entertainment of guests is separated from the original Koṭha-deśa (or *Khasmahal*) of the king by the seal and signature (*Śrī-hasta-santake*) of the king who poured water on the gift of land (*pāṇi-chhāḍilā-bhumī*) or donated the land to Brāhmaṇas of various *gotras* on the auspicious occasion of Simha-Bṛihaspati (when Jupiter is in Leo) in the stream of the river Gautamī (i.e. Godāvarī).

The gift of *Vīra-śrī-Gajapati-Gauḍeśvara-ṇavakoṭi-Karṇāṭa-Kaḷavara-rgēśvara Mahārāja* Kapileśvaradeva consists of Jāgēśvarapura-śāsana, Belamapura-śāsana and Pratāpa-Kapileśvara-pura-śāsana and these three *śāsanas*, consisting of 40 *bhāgas* (shares) each, comprise 120 *bhāgas* in total including homestead land, garden land and cultivable wet land.

I make the donees enjoy the lands of the village and the village itself declaring it free from all imposts including thirty-six taxes.

¹ This form of *ha* is still in use in the Karāṇī script. There is no sign of superscript *r* with it.

² Dr. Sircar's reading is *purṇa*. The *y* sign in this letter is the same as that *nya* in *māinya* line 10.

³ This stands for *madhye* in Karāṇī writing.

⁴ This letter is *ṭa*; but the word *tolā* does not give any sense. *Bāḍi-tolā-jaḷabhumī* means homestead land, garden land and cultivable land.

FOUR VIRABHADRA ICONS AND THE LINGAYATA SECT

By AMITA RAY

In course of my studies in archaeology and museology at the Rijksmuseum Voor Volkenkunde at Leiden I came across, in 1959 last, four metal plaques, three in bronze and one in brass, representing a Brahmanical divinity showing more or less the same iconographic characteristics and attributes and standing in slightly differing poses and attitudes. In the records of the museum the images are entered as having been acquired in and brought over from South India. Two of these figures (Figs. 1 and 2), each of which is executed more or less in bold relief against a flat background, are endowed with four hands, the right hands showing respectively the arrow and the sword, and the left, the bow and shield. The third figure (Fig. 3) has only two hands, the right holding vertically a sword, and the left resting on the shield. The fourth one (Fig. 4) has again four hands, but the upper right hand, instead of showing the *vāṇa* or arrow, holds an attribute which can be described as a club with three round knobs; the left hands show the arrow and the bow, the arrow obviously being misplaced since it is shown in the left instead of in the right hand. All the figures, especially Figs. 1, 2 and 3, are richly ornamented with all kinds of traditional ornaments. At least two of the figures are provided with *jaṭā mukuta*, of which one at least (Fig. 1) is shielded over by the five hoods of a snake. The fourth figure (Fig. 4) also has on its top a five-hooded snake. All the figures have a long and heavy garland of skulls hanging down from their neck. All the main figures except one (Fig. 3) are shown in a striding attitude as if walking forward on wooden sandals and are flanked by two figures, one on each side, though the main figure (Fig. 3) shows only one figure standing on the right. The figure on the right (Figs. 1, 2 and 3) is a human figure with a goat's head, which is everywhere shown in a worshipful attitude with folded hands. In Fig. 4, however, this goat-headed figure is placed on the left, but here, too, it is represented in an *añjali* pose. The figure to the left of the main divinity (Figs. 1 and 2) is evidently that of a female divinity. But in Fig. 1, this female divinity holds in her right hand the sword in a vertical position while the left hand is shown hanging along. In Fig. 2, however, both the female figures seem to be standing in *añjali* pose. In Fig. 4 the figure to the right, which seems to be a male figure, is also shown in the same pose. On either side of the top of all the main figures there are representations of the Sun and the Moon, the Sun in two cases being on the right and the Moon on the left; in two other cases the position is, however, reversed. In the fourth figure (Fig. 4), there is in addition the representation of what seems to be the bull, Nandi, on the right and that of the Śiva-*lingam* on the left. On the pedestal of the figure, represented in Fig. 1, there is also the representation of what seems to be a crouching bull, evidently the Nandi.

There cannot be any doubt that here are representations of a divinity that must belong to the Śivaite pantheon. From *pratimā-lakṣaṇa* texts the divinity can easily be identified as the Virabhadra form of Śiva assumed by the god at the time of the destruction of the *yajña* of Dakṣa. Legends say that Virabhadra was created from the wrath of Śiva, that Dakṣa,

the father of Sati or Umā, terrified by the wrath of the god, stood in awe and reverence in *añjali* pose before Śiva-Virabhadra, also that Daksha had the head of a goat with two horns. In the present examples the face of the main figure does not have a very fierce expression; it is rather pacific in all these cases, but the goat-headed Daksha in *añjali* pose discloses the real nature of the composition. The female figure to the left can be identified, on the basis of mythology, with Bhadrakālī, the counterpart of Pārvatī, who is supposed to have been present helping Virabhadra destroy Daksha's sacrifice. But in at least one instance (Fig. 4) the other figure is definitely that of a male. It has been suggested by some that this attendant is Brahmā, for which, however, we have no textual support. It has also been suggested that instead of Brahmā this figure may represent Garuḍa, which, too, has no textual basis. Virabhadra, according to the texts, is one of the *gaṇas* or attendants of Śiva, who seems to have been derived from non-Aryan demonolatry.¹ He is described in the texts to have a thousand heads, a thousand eyes, a thousand arms, powerful shoulders and side tusks. He is further described as having *saṅkha*, *chakra*, *dhanu* and *vāṇa* as his attributes.² The *Śilpa-saṅgraha* mentions the three varieties of Virabhadra, namely the *sāttvik*, the *tāmasik* and the *rājasik*. The figures reproduced here may easily be taken to represent the *sāttvik* variety.

Images of Virabhadra and shrines dedicated to him are very common in the Telugu and the Canarese districts of the South. There is also evidence to suggest that Virabhadra as a form of Śiva was very popular among the powerful Liṅgāyatas of the South.³ Long ago Thurston suggested that at least a certain section of the Jaṅgamas or priests of the Liṅgāyata sect used to hold Virabhadra in great veneration. He had noticed that some of these priests used to hold in their left hand or wear huge metal plaques with representations on them of the image of Virabhadra in a more or less clear relief. According to his interpretation these plaques were used by them as shields or amulets to protect them against evil eyes and acts.⁴ He also provided a photographic representation in support of his suggestion and interpretation (Fig. 5).

The metal plaques from the Volkenkunde Museum at Leiden seem to lend strong support to Thurston's hypothesis that the plaques were presumably hung from the neck or held by the hand with the aid of a fastener. This is proved by the fact that one plaque is provided with a handle at the back for gripping, two plaques with two fasteners presumably for fixing the chain, and another with four holes in four corners.

The hypothetical association of the Virabhadra form of Śiva, with the Jaṅgamas of the Liṅgāyata sect of the South, raises certain interesting questions in respect of the religion and religious ideology of the Liṅgāyatas, who also describe themselves as 'Vira-Śaivas' and 'Śiva-bhaktas'. According to texts and traditions, the Liṅgāyatas are not supposed to worship any image. In fact, their religious texts and their myths are altogether silent about the gods, and hence also about any of the anthropomorphic forms of Śiva. By the very derivation of the term, a Liṅgāyata is one who bears the *liṅga* or the phallic symbol, or one who belongs to the arena of *liṅga*, that is one who is a worshipper of the *liṅga*. *Liṅga* or the phallic

¹ *Encyclopaedia of Religion and Ethics*, Vol. V, p. 22.

² Rao, Gopinath: *Elements of Hindu Iconography*, Vol. II, Part I, p. 183.

³ *Channa Basava Purāṇa*, translated by Rev. G. Würth in the *Jour. B.B.R. As. Soc.*, Vol. VIII, p. 101.

⁴ Thurston, E.: *Castes and Tribes of Southern India*, p. 257.

symbol is, therefore, evidently the object of worship and veneration of the Lingāyatas.⁶ Indeed, the worship of this symbol is the chief feature of the members of the Lingāyata sect; next in importance of veneration is the guru and finally the *saṅgha* or the sect itself. 'The guru is the preceptor, who imparts to the aspirants spiritual knowledge, the Jaṅgama is the realized soul and the *liṅga* is the deity Śiva.'⁶

Knowing that the Lingāyatas do not worship any form of Śiva other than that of the abstract *liṅga*, how is it that the Jaṅgama priests wear a plaque representing Śiva's Virabhadra form? Is there really anything that can connect the Jaṅgamas with Virabhadra?

In the *Basava Purāṇa* of the Lingāyatas we are told that the god (Śiva), in order to prevent evil, injury, falsehood and faithlessness, should take the form of the Jaṅgama to go to the world of the mortals with a view to refuting and wiping out all false religion and making men adore Śiva in order to protect them.⁷ From this point of view the Jaṅgamas are not merely the priests, but they are themselves incarnations of Śiva, brought into being to fight the enemies of Śiva and Śivaism.

According to the *Kūrma* and *Bhāgavata Purāṇas*, as recorded by T. A. Gopinath Rao, it is well known that Virabhadra was created from the locks of Śiva with the sole objective of killing Daksha who, for all that we know, was a believer in Viṣṇu and upholder of Vaiṣṇavism.⁸ The *Basava Purāṇa*, referred to above and datable perhaps in the twelfth century, tells us further the story of how the eyes of the two of Basava's disciples were put out by Vijjala and of how Vijjala in his turn was killed by Basava's followers.⁹ The *Siddhāntasikhāmaṇi* of the Śaivas also states that if anybody shows disrespect to Śiva, he should be killed at once.¹⁰ This would show that amongst a certain sect of the Śaivas of South India there was a definite tendency towards thinking and acting in terms of aggressive violence in respect of those whom they considered as their contenders or enemies.

It is not unlikely that the Lingāyatas, otherwise known as Viraśaivas, were one such militant sect. We have been told that the Viraśaivas were called as such because of their heroic attitude in an aggressive and defensive manner in support of their faith.¹¹ We are also told that in order to save the religion (Śaivism) from disgrace, a true Lingāyata should risk his life, even if it means taking recourse to violent means.¹²

This militant attitude of the Viraśaivas or Lingāyatas seems to distinguish them sharply from other sects of the Śaivas. It is not, therefore, perhaps difficult to understand why Virabhadra should occupy a special place of honour and veneration with the Lingāyatas, because Virabhadra himself is supposed to represent a terrifically militant and aggressive form of Śiva. According to Purāṇic legend, Daksha, a devotee of Viṣṇu,

⁶ Channa *Basava Purāṇa*, Jour. B.B.R. As. Soc., Vol. VIII, pp. 125-127; Rao, Gopinath: *Elements of Hindu Iconography*, Vol. II, Part I, p. 33.

⁷ Mazumdar, R. C. (ed.): *History and Culture of the Indian People*, Vol. V, p. 449.

⁸ *Basava Purāṇa*, translated by G. Wüth in the Jour. B.B.R. As. Soc., Vol. VIII, pp. 66-67.

⁹ Rao, Gopinath: *Elements of Hindu Iconography*, Vol. II, Part I, pp. 182-183, 185-186.

¹⁰ *Basava Purāṇa*, Jour. B.B.R. As. Soc., Vol. VIII, p. 96.

¹¹ *Siddhāntasikhāmaṇi*, Chapter IX.

¹² Das Gupta, S. N.: *A History of Indian Philosophy*, Vol. V, p. 42.

¹³ *Siddhāntasikhāmaṇi*, Chapter IX.

refused to make offerings to Śiva. Virabhadra, therefore, put out the eyes and plucked the teeth of Sūrya, cut off the hands and tongue of Agni, cursed Indra's arm to stiffness, crushed Chandra or the Moon by his toe and obliged Garuḍa to flee for his life.¹³ Such was the powerful, aggressive and militant Virabhadra who caused havoc to the non-believers of Śiva's power and made all the Śaiva sects, including the Virāśaivas or the Liṅgāyatas, accept his supremacy. This would perhaps explain why Virabhadra occupies such an important position with the Liṅgāyatas.

The use of the Virabhadra plaques as protective shields or amulets can also be satisfactorily explained. It is very well known that copper and *ashta dhātu* (alloy of eight metals) are considered sacred by the Liṅgāyatas. Over dead bodies of members of their sect, they are known to place 21 small pieces of copper or *ashta dhātu* on which is engraved the sacred formula of the sect in order to protect the corpse from evil spirits.¹⁴ It is not unlikely, therefore, that the members of the sect, especially their priests, even when alive, should wear copper or *ashta dhātu* metal plaques engraved with the image of a divinity that was supposed to reflect their character and religious ideology.

Of the four figures, that of Fig. 1 is certainly plastically the best and the earliest from the point of view of artistic form. Its decorative and iconographic embellishments, its quality of linear movement and plastic treatment affiliate the image to the classical Chola stylistic tradition, though a slight stiffening of the plasticity of movement seems to suggest that it belongs to a slightly later date, probably to the thirteenth century. Figs. 2 and 3 are definitely much later and, though they still indicate the classical tradition, they cannot belong to earlier than the fifteenth or the sixteenth century; Fig. 3 may even be later. Fig. 4 belongs clearly to the folk tradition and is typical of eighteenth- and nineteenth-century metal images of the *bazaar* tradition of image-making for the ordinary folk.

The image on the relief of the shield, held by the Jaṅgama priest (Fig. 3), seems to belong to the same tradition as that of Figs. 2 and 3, which seem to prove that already by about the fifteenth century the association of Virabhadra-Śiva had become established. But this association can be pushed further back, even to as early as the twelfth or thirteenth century, to which period, roughly speaking, Fig. 1 seems to belong, since the stele of the figure is also provided with a handle for its use as a shield. Therefore there can be no doubt that this stele was also meant for being held as a shield by the Jaṅgama priest.

¹³ Rao, Gopinath: *Elements of Hindu Iconography*, Vol. II, Part I, p. 184.

¹⁴ *Encyclopaedia of Religion and Ethics*, Vol. III, p. 443.

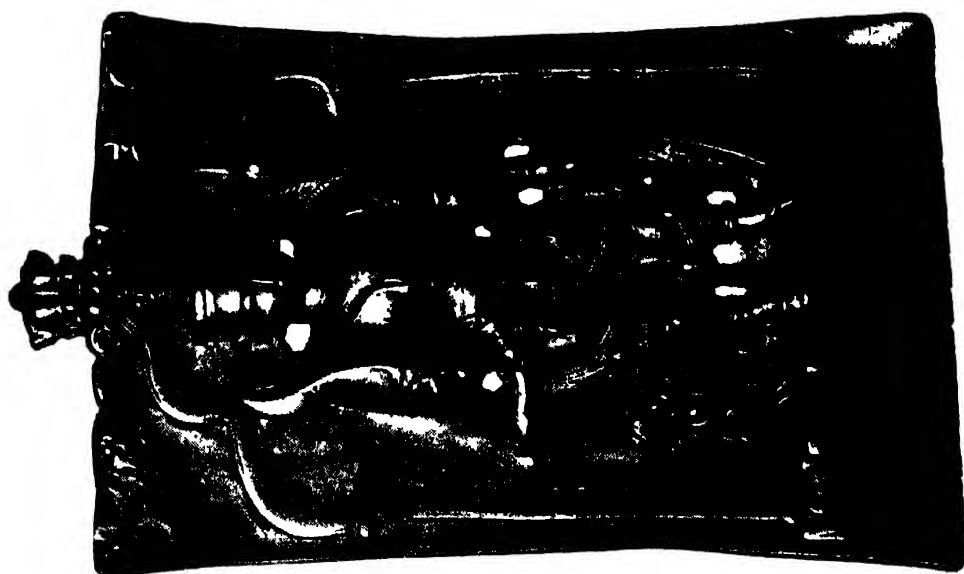


FIG. 3.



FIG. 2.

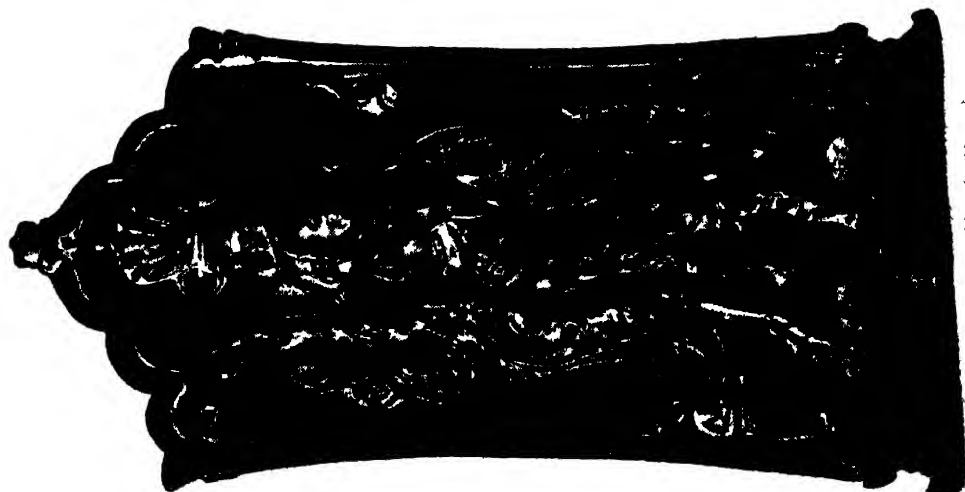


FIG. 1.

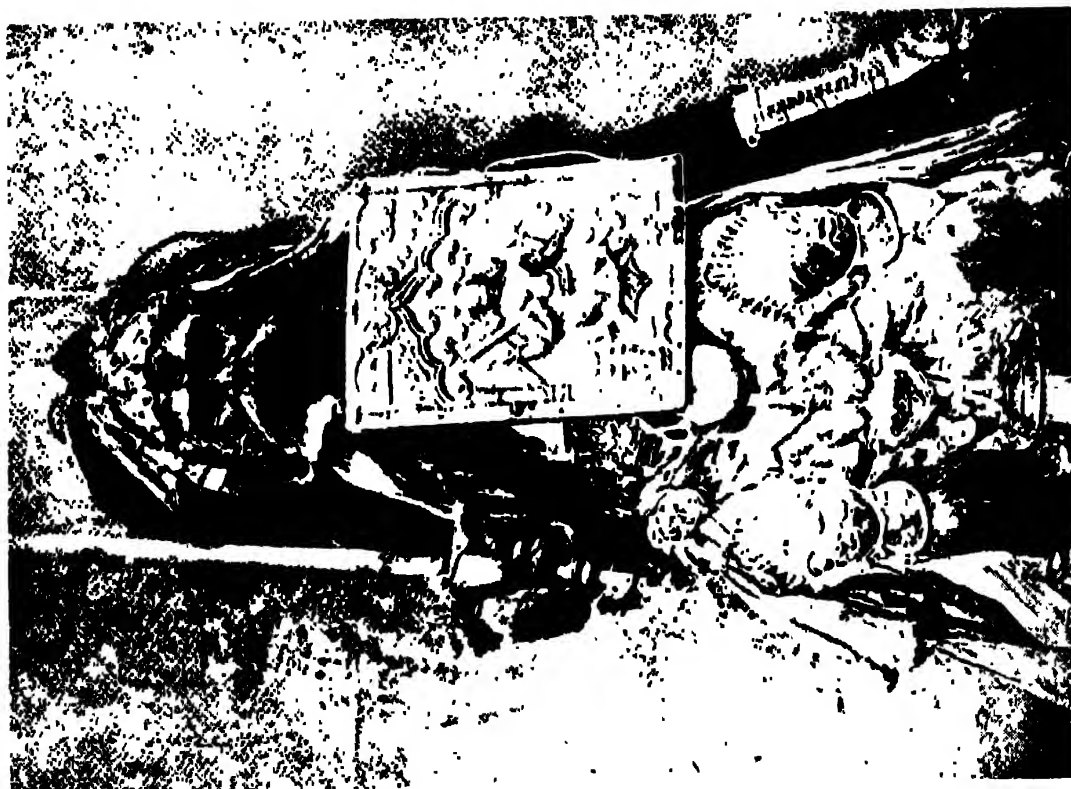


FIG. 5.

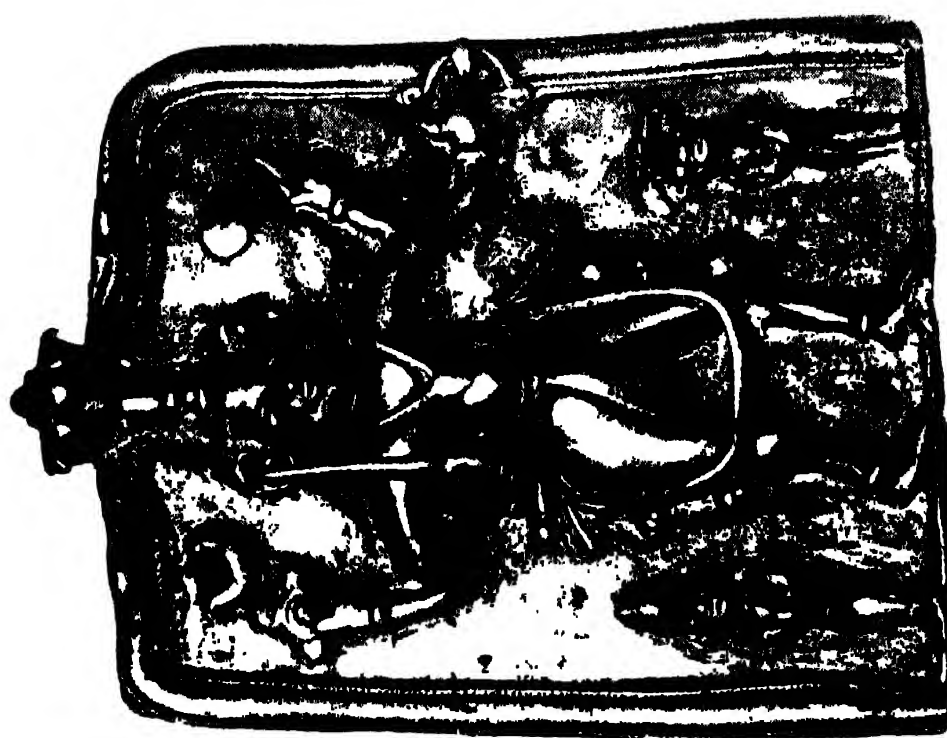


FIG. 4.

EFFECTS OF CALCUTTA SEWAGE UPON THE FISHERIES OF THE KULTI ESTUARY AND THE CONNECTED CULTIVABLE FISHERIES¹

By AUGUSTINE DAVID

(Central Inland Fisheries Research Sub-station, Allahabad)

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INTRODUCTION

The present investigations relating to the effects of Calcutta sewage on the fisheries of the Kulti estuary were initiated in 1948, pursuant to the complaints of fish farmers of Kharibaria near Calcutta that the Kulti no longer served as a 'seed' resource for culture fisheries since 1939 when the sewage from the city began to be discharged into it. Several species of Mulletts, the Bhetki—a perch—some minor Fishes and a number of Prawns are extensively cultivated in these brackish-water fish farms, locally known as 'bhashabada' fisheries or 'bheris' (*vide* Sewell, 1934, Hora and Nair, 1944 and Pillay, 1954). The affected farms extend to an area of nearly 75 sq. miles to the north and north-east of Calcutta within a radius of about 50 miles and are capable of supplying appreciable quantities of freshly caught Fish and Prawns daily to the city's markets.

Some knowledge is now available in India on the effects of industrial wastes' pollution on freshwater streams and rivers from the observations conducted by Hora and Nair (1944), Bhimachar and David (1946), Ganapati and Alikunhi (1950), Ganapati and Chacko (1951), Banerjea, Motwani and Karamchandani (1956), Motwani, Banerjea and Karamchandani (1956) and David (1957). Nair (1944) and Bose (1944) have discussed at length the problem of sewage pollution in India with reference to the Kulti estuary and Calcutta sewage disposal. Whereas the estuarine and foreshore areas entirely differ in scope and manner of pollution from the freshwater rivers, the standards of assessment also differ widely due to the tidal effects and salinity. In other countries, estuarine and foreshore pollutions affect

¹ Published with permission of the Director.

mainly the spawning runs of Salmon or Shad and also damage oyster beds (Alexander *et al.*, 1935 and Galtsoff *et al.*, 1947), but the problem presented by the Kulti concerns a damage caused directly and indirectly to fairly rich capture and culture fisheries.

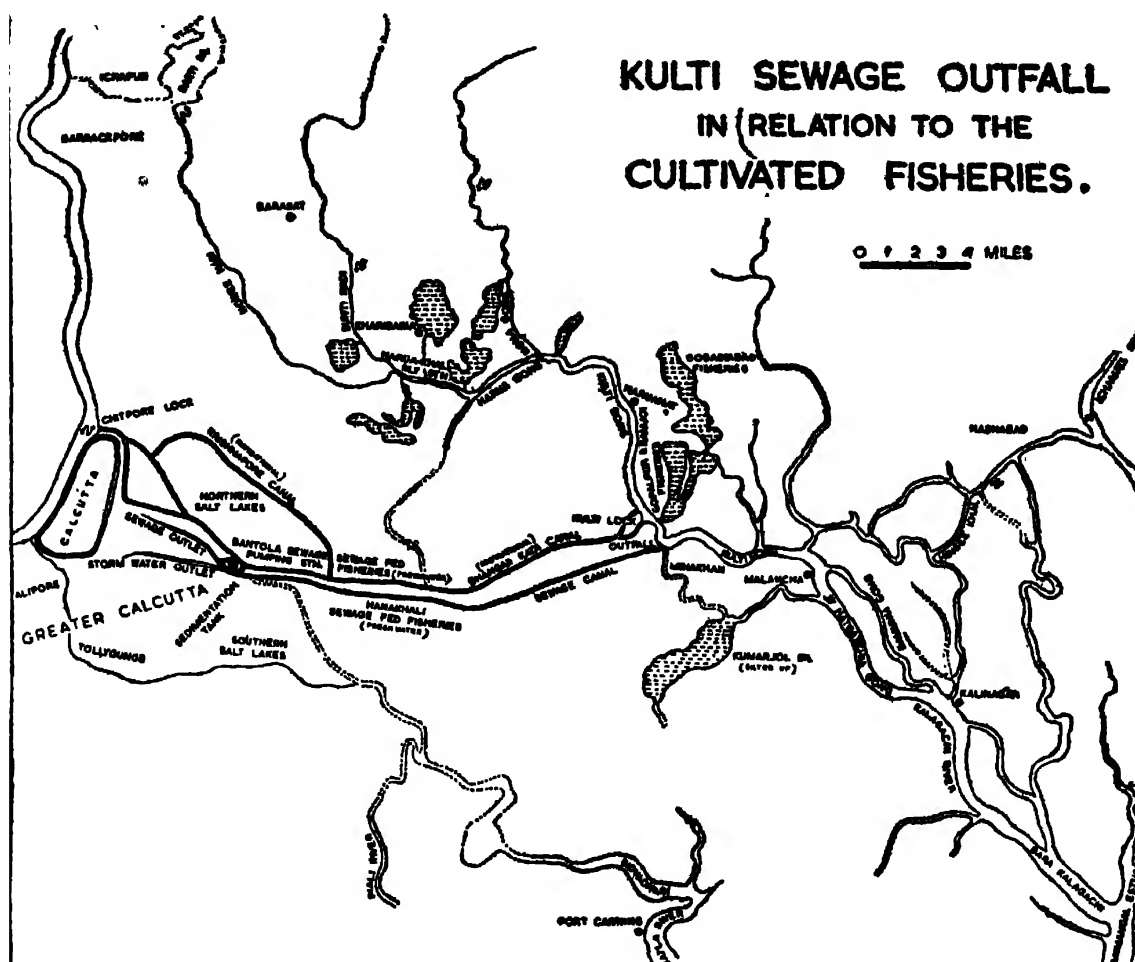
HYDROGRAPHICAL FEATURES OF THE KULTI ESTUARY

A brief description of the Kulti and its surroundings is essential for a proper understanding of the peculiar hydrographical features involved, as pollution is linked closely with the tides and topography. Deltaic Bengal is formed of rich alluvium and clay brought by the combined waters of the Ganga and the Brahmaputra rivers, which enter the Bay of Bengal through the Meghna in East Bengal at the extreme eastern end of the delta now in East Pakistan (Majumdar, 1942 and David, 1953). Between the seasonally alive Hooghly and the perennial Meghna are a number of tidal creeks which are no better than incoming arms of the sea scattered over an area of 6,000 sq. miles. The majority of these tidal rivers are interconnected by channels, the rich overlying soil being covered by the almost impenetrable 'Sunderban' forests. The Kulti estuary is part of an off-shoot from the Royamangal estuary and is variously known as Barakalagachi, Kalagachi, Hatgachiagong, Kultigong and Haruagong to its termination into three narrow arterial channels, the Nonagong, the Sunthee and the Nowee (refer map). The latter are three tidal rivulets spilling into the brackish-water culture fisheries around Kharibaria and swamps in the north-east of Calcutta. The Kulti creek from the junction of Sunthee to Malancha, the stretch now studied, is about 18 miles. The distance between the Kulti outfall to the junction of Barakalagachi with the main Royamangal is 24 miles and to the sea about 80 miles.

In the Bengal estuaries, the tidal pulses travel between 120 and 180 miles from the sea owing to a very low gradient of less than one inch per mile, subjecting the low-lying delta constantly to scours and sedimentations. There are extensive water-logged swamps many of which are converted into rich 'bheris'. Ramjoi and Gobadiabad fisheries, extending together to over 7,500 acres, are the largest near the outfall that open into the sewage mixed waters of the Kulti (map).

There are no perennial sources of flush water to the Kulti *above* the point of sewage outfall, but the Sealdahgong about 5 miles below (map) brings a fair amount of tidal water from the Ichhamathi through the Hinsee Khal and also serves to take away some of the contaminated water. Some fresh water also is brought through it during monsoon months from the Ichhamathi which receives then considerable amount of spill water from the flooded Padma river. Run-off water over a catchment of about 250 sq. miles through the arterial channels of the Nowee, Sunthee and the Nonagong, as well as about 150 sq. miles of catchment over Calcutta and adjacent areas render the Kulti fresh for two months in August and September.

Between 1920 and 1930, sewage disposal became a matter of great concern to the authorities of Calcutta Corporation due to the deterioration of the Bidyadhari, an adjacent tidal creek originally used to carry away Calcutta sewage, and the authorities (Banerjee, 1931 and 1935, and Banerjee and Ganguly, 1947) selected the Kulti as the best medium to carry away the growing load of sewage after a close study of its favourable hydrographical features. The channel depths of the Kulti vary up to 42 feet near the outfall site during high tides. The margin between the lowest low tide and the highest high tide is about 17 feet. During the neap periods a margin of 8-11 feet is usually observed between tides. Average high



water level at the outfall site is 14.50 feet and low water 3.33 feet above the datum. Maximum flood discharge of 27,000 cusecs and ebb discharge of 24,000 cusecs have been recorded at the outfall site, but these figures dwindle to as low as 8,000–9,000 cusecs at low tides, the periods of maximum sewage concentration. Average discharge at 3 feet per second at the outfall site is about 17,000 cusecs, even though maximum velocities of 4.76 and 5.78 feet per second ($3\frac{1}{2}$ to 4 miles an hour) are recorded respectively at flow and ebb tide currents. Considering the cross-sectional areas, the amount of water flowing at any particular point varies considerably within a short distance of about 15 miles. At Haruahot it is less than half as much as at the outfall, but is nearly double at Minakhan and 5-6 times at Malancha.

MODE OF SEWAGE DISCHARGE AND DISSIPATION

The sewage channel from Bantola (where sewage is collected, sedimented and pumped) to the outfall is 17 miles with a slope of 6 feet between points, or less than 5 inches per mile. Methods of sewage treatment are described by Bose (1944) and Nair (1944). The original dry-weather channel proposed to carry only sewage has not been completed and the sewage flow is thereby diverted part of the way directly into the partially completed storm-water channel. Almost all the solids in suspension are dropped in the head reach of the storm-water channel and the incompletely treated liquid sprawls over it taking nearly eight days to reach the outfall. The bed level of the dry-weather channel at the outfall is lower by about $3\frac{1}{2}$ feet from the average low water level of the Kulti. This entails building

up of a head in the sewage outlet before it can discharge into the Kulti twice daily during low tides.

The sewage channel is designed to carry a maximum load of 670 cusecs of combined sewage and storm water from Calcutta, though its normal requirement is to discharge about 272 cusecs or 150 million cusecs of sewage per day. At the outfall the channel is provided with 16 vents with a total capacity of 2,200 cusecs discharge, but in actual practice five vents are generally kept open, except during monsoon bursts or near-drought conditions, discharging about 688 cusecs or 4,286 gallons per second. During monsoon months additional gates are opened to prevent spilling of septic sewage on the outlying areas as storm water from the city and around the channel itself has to be drained. Between February and May all the vents except one remain closed for short durations to prevent too much discharge of sewage, when in some years nearly 60 per cent of its water is utilized raw for freshwater pisciculture (mainly Carps) in the Bidyadhari, Bantola, Dhapa and Hanakhali areas.

Sewage discharge occurs 20-22 days in a month as the gates are completely closed for 2-3 days on each side of the full or new moon days during spring tides. Periods of actual discharge have varied from $5\frac{1}{2}$ to 13 hours per day. The levels of water in the sewage channel are comparatively stable in relation to the fluctuating Kulti, where the level first becomes flush with the vents and rises five feet above the normal level of discharge head. Table I gives a fair idea of sewage discharge as gathered from a test record during May and June, 1947, for each of the first and second tidal phases in the course of a day.

There were 22 days in May when sewage drained into the Kulti on an average of 8 hours and 13 minutes per day. Similarly, sewage drained for 9 hours and 20 minutes on an average for 21 days during June.

The ebb flow carries the sewage first downwards for about 2 hours once discharge commences. As the level near the outfall decreases more sewage is drawn into the estuary, when the ratio of sewage increases to 1 : 12 from 1 : 43 within about 3 hours. At the turn of the tide, this surcharged mass, now concentrated near the outfall and diluted for 5 miles below, is lifted upwards for a duration of about 5 hours. Hence nearly a distance of 7-8 miles towards Malancha inclusive of Sealdahgong is affected first by a downward moving mass of sewage and the entire Kultigong above for 18-20 miles by the upward flowing mass of the same sewage. All the time more and more sewage is still being drawn into the Kulti from the sewage channel, surcharging the Kulti as the level decreases. The sewage-mixed upper extremity travels still further for the next 3-4 hours a distance of 6-10 miles entering the arterial channels, finally spilling into the brackish 'bheris' near Kharibaria and other fisheries. As long as the sewage drainage does not cease, this concentrated mass oscillates only within the stretch above the outfall, rendering the estuary a vast septic tank. Channels of the Nowee, Sunthee and the Nonagong and their connecting culture fisheries therefore receive only this concentrated sewage instead of fresh estuarine water in the absence of a by-pass or source of uncontaminated water. It is only 5 miles below the outfall that the sewage-laden water can normally get diluted or dissipated otherwise by an addition of water from the Sealdahgong or lower Kulti as described earlier (map). It is obvious that under the above conditions the upper 24-30 miles of the Kulti and Haruagong above the outfall progressively become loaded with sewage, as the column of drained sewage cannot get past the outfall without receiving still more sewage.

There is no drainage of sewage generally during levels above $10\frac{1}{2}$ feet

TABLE I
Showing Averages of Sewage Drain

	Drainage Starts (Levels in feet)			Drainage Stops (Levels in feet)			Total Drainage Period (In hours and minutes)		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
May, 1947—I Phase	11' 6"	6' 2"	7' 3"	9' 11"	4' 10"	5' 4"	6-10	2-45	4-03
II Phase	13' 8"	6' 0"	7' 9"	10' 0"	4' 5"	6' 1"	7-05	2-50	4-12
June, 1947—I Phase	11' 6"	6' 7"	9' 2"	8' 8"	4' 9"	6' 1"	6-20	2-50	4-25
II Phase	13' 4"	6' 6"	9' 1"	9' 4"	4' 9"	7' 0"	6-30	2-50	4-55

and some uncontaminated water can then reach the outfall region from the lower estuary for about 2 hours during flow tides. When sewage drain is stopped during high spring conditions, the sewage-ridden water above the outfall continues to dissipate below, neutralizing any slight beneficial conditions the flow tide currents might have brought about in the water.

METHODS AND MATERIAL

The above hydrographical features of the Kulti estuary were considered for purposes of sampling since the outfall point can be defined as either polluted or fresh in relation to the height of the tide. The higher the tide, the farthest downstream is the point from which contaminated water would have travelled to the outfall site. Similarly, the lowest the tide, the pollution would be at its maximum and the water examined just above the outfall would have travelled from a remote point above. (Pollution studies in an estuary are conducted considering such tidal factors, unlike in a freshwater river where a continuous stretch has to be examined.) Hence high tide samples of surface water and tow-net plankton hauls at slack periods showed conditions prevailing 10–15 miles below. Likewise, low tide samples just before the slack showed the worst conditions in the sewage-mixed estuary water. A low tide sample taken $1\frac{1}{2}$ miles above the outfall site, close to the Kulti lock (map), revealed the quality of water and plankton that can be expected to move into the arterial channels at high tide. In all 13 sets of water samples and 14 sets of plankton were obtained during 14 visits between 1954 and 1955. Such visits were given within a day or two from a full or a new moon day at spring tides and represented the *best conditions of the Kulti*, as sewage flow was generally stopped for 3–5 days for reasons mentioned earlier. Three such visits when only plankton and fish were examined had also been given during 1948.

Fishes were obtained from fishermen operating various gear and examined fresh. Fishery conditions and distribution of burrowing or mud-flat fauna were studied first-hand, whenever possible, several times.

Hydrographical conditions pertinent to this study were gathered from reports available with the Director, River Research Institute, West Bengal, and the Corporation of Calcutta.

PHYSICO-CHEMICAL NATURE OF AFFECTED WATER

Under normal conditions the decaying processes at work in the Bengal delta are determined by the velocities of tides, rate of sedimentation or scouring and amount of upland flushing water. The tidal Kulti has several times shown signs of deterioration and recovered promptly as available reports show. Bose (1945) has stated that addition of sewage has not altered the physical conditions for the worst as the total solids and salinity of the river under all conditions of tide and season are always greater than those of sewage samples, showing that the effect of sewage on the Kulti is more of dilution at least in the above respects. The huge amounts of colloidal organic matter deposited do not perceptibly act as sensitizers to the silt, nor do they affect the rate of sedimentation even at the slack period of 40–60 minutes between tides. The amount of dissolvable organic matter thrown by Calcutta sewage in 1940 (according to Calcutta Corporation's estimates) into the Kulti was of the order of 7–8 million cubic feet in a year. This would have easily doubled itself during 1954–55 in proportion to the increase in population and expansion of sewers.

Table II indicates the values of chemical tests on samples of water.

Results of analysis of raw sewage at various places along the channel till its outfall are given variously by Bose (1944), Nair (1944) and Basu (1950).

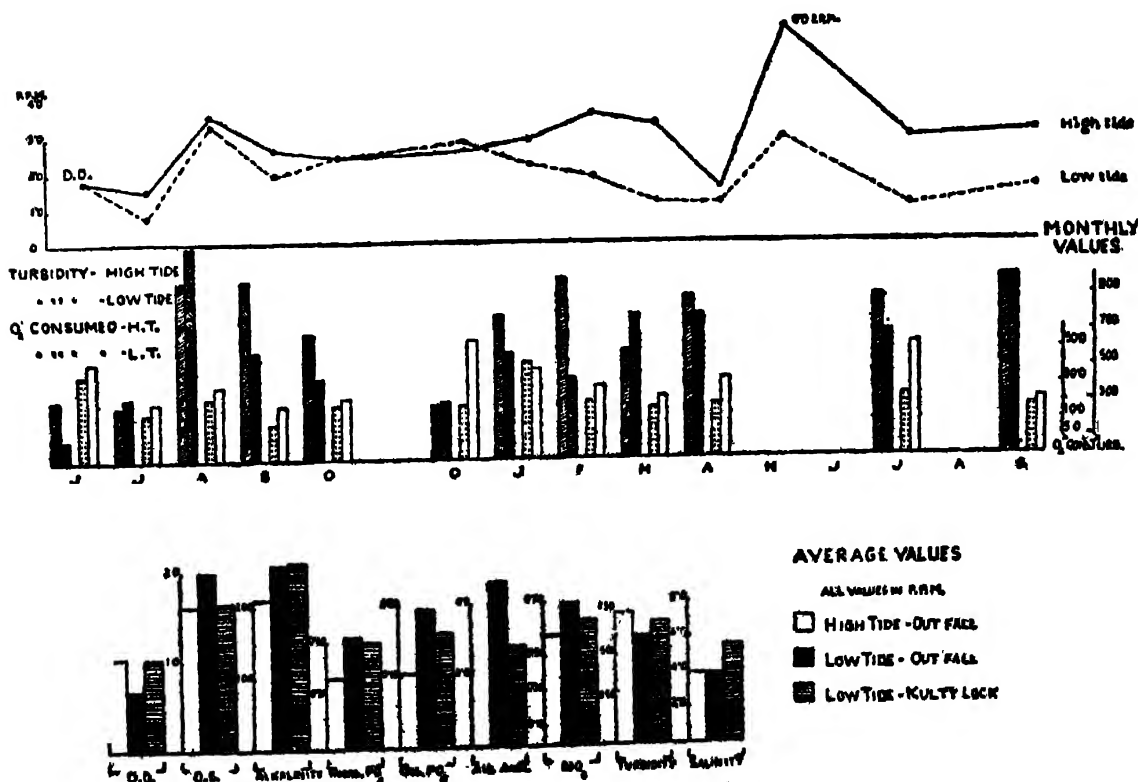
It is observed that mean turbidity figures for the low and high tides are 737 and 611 respectively at the outfall, which are not very high compared to a maximum of 2,500 in the Hooghly in its cleaner section (Bose, 1956). The turbidities encountered in the Kulti do not seem to form a limiting factor for the phyto-plankton production as they are well below levels considered unfavourable.

Little if any silt tends to deposit itself at the bottom except during the short slack periods between tides. Silt deposition, however, has been calculated at 0.54-1.89 m.c. ft. per mile above the outfall, but at the same time a scour of 2 feet during monsoon offsets any marked silting up of the river bed. Particles below 0.02 mm. form almost 100 per cent of the total silt carried by the river, but at times 0.113-8.301 per cent of the silt constitutes larger particles of over 0.075 mm., including minute quantities of sand.

Deterioration of Kulti's upper arterial channels and connected fisheries has actually been in progress due to natural causes of silt deposition or reclamatory practices even before the sewage was introduced. Silt beds, however, are not formed within the Kulti wholly due to sewage action as in many other tidal waters which are not subjected to high velocity currents and receiving heavy amounts of sewage loads from large cities.

At the outfall site a discoloration of water and foul smell can always be detected, disappearing only at high tide slack periods. This does not denote that the water is actually free from pollution at high tides (please refer to D.O. and other values). No solids are thrown into the estuary. Owing to the rapidity of currents, no agglutinated organic particles can settle anywhere in the estuary and the bottom is remarkably free from all signs of organic disintegrated scum and the outfall site cannot be measured from standards of conditions prevailing at similar outfall sites in freshwater rivers.

The pH values observed have a mean value of 7.4 both during high and



low tides at the outfall site, whereas 6.8 to 7.0 are recorded for the raw sewage by Basu (1950). Any minor variations of pH alone in the estuary do not indicate harmful effects on the fish or other organic life, since such values are well within limits prescribed for productive waters.

Dissolved oxygen (D.O.) has only once shown a maximum of 6.0 p.p.m. with a mean reading of 2.68 p.p.m. (13 readings) during high tides. At a time therefore when there should have been an influx of highly oxygenated and fresh tidal water from the lower sections, the D.O. was still poor. Mean values of D.O. at low tides are 1.89 (lowest being 0.8 p.p.m.) and the highest 3.73 p.p.m. in August, at a time when supposedly better conditions should prevail owing to rains. Low tide mean at the Kulti Lock is 2.7 p.p.m. Irrespective of the tidal conditions, the D.O. is consistently far below the normal (5.6 p.p.m. lowest mean noted by Bose, 1954, in the Hooghly) and seems to be quite insufficient for a healthy existence of organic life including fish. These low values tend to enhance any toxic effect already present in the river on fish which could otherwise survive oxygen deficiency to a marked degree.

Similarly, Oxygen Consumed (half-hour in KMnO_4 at $100^\circ\text{C}.$) has varied between 11 and 32 p.p.m. under all tidal conditions. The mean values of 16.16, 20.75 and 16.75 p.p.m. respectively at high and low tides at the outfall and at Kulti Lock at low tide are decidedly high. Oxygen Consumed being proportional to the strength of sewage is generally high, indicating a large load of organic matter at all times.

Alkalinity figures show mean values of 210 p.p.m. during high tides as compared with 259 p.p.m. and 263 p.p.m. during low tides. Even during high tide conditions when there had been no discharge of sewage for 5-6 days, alkalinity was considerably high, showing water's latent capacity for bioactivity.

Albuminoid ammonia combined with traces of free ammonia is indicative of disintegrating organic matter in a sheet of water. Compared with the Tees estuary (Alexander *et al.*, 1935) where albuminoid ammonia was only 0.08-0.82 p.p.m., the average values of 2.32, 4.65 and 2.98 p.p.m. in the Kulti are extremely high. Albuminoid ammonia much above 0.2 p.p.m. is to be regarded with suspicion.

Since presence of nitrate shows treated sewage, values between 0.4 to 1.2 p.p.m. during high tide currents coupled with traces of ammoniacal nitrogen are evidences of a considerable degree of pollution and are of potential hazard to fish life.

Correspondingly increased values are shown by phosphates (both inorganic and organic), which are high even during high tides and indicate the potential capacity for plankton productivity of the Kulti due to fertilization effects provided other undesirable conditions are not present.

Organic matter in the bed silt of the Kulti has varied from 0.4 per cent opposite the outfall to a maximum of 4.0 per cent at the Kulti Lock site and 3.0 per cent at Haruakhal Railway Station (map) and also at Kalinagar at the extremities of the Kulti. This shows the enormous organic matter carried by the Kulti. Organic carbon in silt at the outfall site (200 yards below) has varied between 300 and 780 mg. C/100 of silt, showing the heavy load of humic matter in the river which has contributed towards this absorption.

BIOTAL STUDIES

Plankton

In Table III a list of planktonic organisms noted during various hauls is given. No bacteriological studies were undertaken; it is likely that

due to an admixture of saline water at the tail end of the dry-weather channel and perhaps some inhibitory causes within the sewage water itself, which seems to carry considerable industrial wastes inclusive of toxicants from a gas generating plant, the usual sewage bacteria and fungi are not profuse. *Sphaerolitus* tufts were not observed but stray strands were recognized. Mycelial threads of *Beggiota* and *Zooglea* were found even in high tide samples. Numerous spores of these complex sewage fungi and mucus-like concentrations of mixed *Mycelia* were found, particularly in the sewage-polluted water at low tides. No sessile *Mycelium* of any group was recorded.

Among Protozoans, *Rhizopoda* was the most frequently occurring group. Two to three species of *Diffugia* were recorded almost round the year. *Amoeba* noticed in the raw sewage on a few occasions was not found in the estuary, probably having disintegrated in saline water. Except one species each of *Foraminifera* and *Heliozoa*, both of which undoubtedly were of marine origin, all other related Protozoans were conspicuously absent. Amongst Ciliates, only once a few *Vorticella* were recorded, all other genera being unrepresented. Even in the Hooghly, the number of Protozoans are not too high, but those present occur in fairly large numbers unlike in the Kulti (Dutta *et al.*, 1954).

At least two species of sponges have been noted in the Kulti (as identified from spicules), but their origin was uncertain. Several Medusae ranging between 2 and 35 mm. in diameter were collected once in June, 1954, both at high and low tides, but the majority of them were dead when removed during low tides. Stray hydroid colonies have also been recorded at the same time.

Only three species of Rotifers, e.g. *Brachionus*, *Notholca* and colonies of *Conochilus*, were noted at various times. Obviously they were effluent or freshwater in origin and were probably unable to withstand any prolonged change to brackish-water medium.

Polychaete eggs at various stages of development and sometimes within mucilaginous masses were obtained from a few to fairly large numbers during dry months of increased salinity. None showed embryonic movements or other signs of life. Those kept in jars for observation soon disintegrated, indicating that they were probably dead even before collection.

Among the higher forms, the Copepods were represented surprisingly by not more than three species one of which was *Pseudodiaptomus* sp. Generally these and the majority of unidentified Nauplii were already dead on collection during low tides. No Copepods were recorded at all during July and December, 1955—a remarkable feature in any estuary. Considering that the brackish waters of Bengal are very rich in Copepodan fauna (Sewell, 1934), survival of only three representative species in the polluted Kulti and occasional total absence is directly attributable to the ill-effects of pollution. Dutta *et al.* (1954) recorded that the Copepods are the most abundantly represented group of fauna in the Hooghly estuary and listed some 23 genera as against the three now observed in the Kulti. Cladocerans were entirely unrepresented. Zoea and Mysis of unidentifiable Crustaceans were noted in June and July, 1954, and May and September, 1955. These two were mostly dead when collected. *Gammarus*, referable perhaps to more than one species, and *Sagitta* sp. were obtainable alive occasionally even during low tides and appeared more resistant than other Crustaceans. Megalopa larvae of *Varuna litterata* were found dying in large numbers during low tide currents in July and August. Their clustering masses were also found on the margins, the swarms attempting to escape the polluted water. During high tides they were apparently unaffected.

List of Fishes of the Kulti Estuary

Stray	..	X	Fry	..	F.
Very Rare	..	XX	Juveniles	..	J.
Rare	..	XXX	Adults	..	Ad.
Frequent	..	XXXX			

(No single species can be denoted as occurring 'Very Frequently', 'Commonly' or 'Abundantly' during the studies.)

No.	Scientific Name of Fish	How Occurring	Stage Recorded	Remarks
1	Family <i>Megalopidae</i> <i>Megalops cyprinoides</i> (Broussonet) ..	XXX	Ad.	Few at a time noted in 'bheen' nets.
2	Family <i>Clupeidae</i> Subfamily <i>Clupeini</i> <i>Corica soborna</i> (Hamilton)	XX	J., Ad.	Serial Nos. 2 to 12 are the Clupeids noted variously in the Kulti. (<i>Hilsa ilisha</i> was not noted even as fry or juveniles.)
3	<i>Gadusia chapra</i> (Hamilton)	XXX	J., Ad.	
4	<i>Hilsa toli</i> (Cuvier and Valenciennes) ..	X	J.	
5	<i>Pellona elongata</i> (Bennet)	X	J.	
6	Subfamily <i>Dorosomatini</i> <i>Anadontosoma chacunda</i> (Hamilton) ..	X	J.	
7	Family <i>Engraulidae</i> <i>Anchoviella indica</i> (van Hasselt) ..	XX	J.	This species is the well-known 'Bombay Duck', generally occurring in the Kulti between September and December.
8	<i>Coilia dussumeiri</i> Day ..	XX	J.	
9	<i>Setipinna phasa</i> (Hamilton)	XXX	F., J., Ad.	
10	<i>Setipinna taty</i> (Bleeker) ..	XX	J., Ad.	
11	<i>Thrissocles hamiltonii</i> (Gray) ..	XXX	F., J., Ad.	
12	<i>Thrissocles purava</i> (Hamilton) ..	XX	F., J., Ad.	These forms between serial Nos. 14 and 21 are the fresh-water 'Minnow Carps', usually noticed between July and September when Kulti water almost becomes fresh.
13	Family <i>Scopelidae</i> <i>Harpodon nehereus</i> (Hamilton) ..	XXX	J., Ad.	
14	Family <i>Cyprinidae</i> <i>Amblypharyngodon mola</i> (Hamilton) ..	X	Ad.	
15	<i>Chela labruca</i> (Hamilton)	XX	Ad.	
16	<i>Esomus barbatus</i> (Hamilton) ..	XX	Ad.	
17	<i>Oxygaster bacaila</i> (Hamilton) ..	XX	Ad.	Serial Nos. 22 to 28 are the 'Catfish' species in the Kulti. <i>Mystus gulio</i> and <i>Pangasius pangasius</i> are the only two species of economic value (refer text).
18	<i>Puntius conchoniis</i> (Hamilton) ..	XX	Ad.	
19	<i>Puntius sophore</i> (Hamilton)	XX	Ad.	
20	<i>Puntius ticto ticto</i> (Hamilton) ..	XX	Ad.	
21	<i>Rasbora daniconius</i> (Hamilton) ..	XX	Ad.	
22	Family <i>Tachysuridae</i> <i>Osteogobius militaris</i> (Linnaeus) ..	XX	J.	
23	<i>Tachysurus</i> spp. ..	XX	J., Ad.	
24	Family <i>Plotosidae</i> <i>Plotosus canius</i> (Hamilton)	XX	J., Ad.	
25	Family <i>Bagridae</i> <i>Mystus cavasius</i> (Hamilton)	X	J.	
26	<i>Mystus gulio</i> (Hamilton)	XXXX	F., J., Ad.	

List of Fishes of the Kulti Estuary—contd.

No.	Scientific Name of Fish	How Occurring	Stage Recorded	Remarks
27	<i>Myxus vittatus</i> (Bloch) Family Schilbeidae	XX	J.	
28	<i>Pangasius pangasius</i> (Hamilton) Family Heteropneustidae	XXXX	J.	
29	<i>Heteropneustes fossilis</i> (Bloch) ..	XX	J., Ad.	These two species (serial Nos. 29 and 30) are the air-breathing forms often washed into the Kulti from adjoining freshwater tracts.
30	Family Clariidae <i>Clarias batrachus</i> (Linnaeus)	XX	J., Ad.	
31	Family Anguillidae <i>Anguilla bengalensis</i> (Gray)	XX	J.	
32	<i>Anguilla</i> spp. ..	XX	J.	Serial Nos. 31 to 34 are some of the 'true' eels recorded.
33	Family Moringuidae <i>Raitoborus raitoborus</i> (Hamilton) ..	XX	J., Ad.	Though serial Nos. 33 and 34 are air-breathing, they did not survive in the polluted estuary.
34	Family Ophichthyidae <i>Pisodonophys hijala</i> (Hamilton) ..	XX	J., Ad.	
35	Family Belonidae <i>Tylosurus strongylurus</i> (van Hasselt) ..	XX	J.	These are the 'Gar' fishes and 'Half-beaks'. They were recorded mainly in outer channels connecting the Kulti.
36	Family Hemirhamphidae <i>Hemirhamphus gaimardi</i> (Valenciennes) ..	XX	J.	
37	Family Cyprinodontidae <i>Oryzias melastigma</i> (McClelland) ..	XX	Ad.	
38	Family Mugilidae <i>Mugil cephalus</i> Linnaeus = <i>M. oer</i> (Forskål) ..	XX	J.	These 'Mulletts' have been noted mainly when there was no drainage of sewage.
39	<i>Mugil parsia</i> (Hamilton)	XXX	F., J., Ad.	
40	<i>Mugil speigleri</i> (Bleeker) ..	XX	J., Ad.	
41	<i>Mugil tade</i> (Forskål) ..	X	J.	
42	Family Polynemidae <i>Eleutheronema tetradactylum</i> (Shaw) ..	X	J.	These 'Thread-fins' have occurred only as stray individuals; <i>P. paradiseus</i> in July-September only.
43	<i>Polydactylus indicus</i> (Shaw)	X	J.	
44	<i>Polynemus paradiseus</i> (Linnaeus) ..	J., Ad.		
45	Family Channidae <i>Channa gachua</i> (Hamilton)	XX	Ad.	These are 'Murrels', also known as 'Snake heads', and have occurred in monsoon months.
46	<i>Channa punctatus</i> (Bloch)	X	J., Ad.	
47	<i>Channa striatus</i> (Bloch) ..	X	J.	
48	Family Amphipnoidae <i>Amphipneus cuchia</i> (Hamilton) ..	XXX	F., J., Ad.	This 'Mud eel' is recorded all the year round.
49	Family Centropomidae <i>Ambassis baculis</i> (Hamilton)	X	J., Ad.	
50	<i>Lates calcarifer</i> (Bloch) ..	X	J.	This is the 'Bhetki', a Perch, cultivated in the connected 'bheris'.
51	Family Theraponidae <i>Therapon ferbus</i> (Forskål)	X	J.	
52	Family Sillaginidae <i>Sillago panijus</i> (Hamilton)	XX	J., Ad.	'Crocodile' fish recorded during monsoon months.
53	Family Carangidae <i>Caranx carangus</i> (Bloch)	XXX	J., Ad.	
54	Family Lobotidae <i>Lobotes</i> sp.	X	J.	Serial Nos. 53 to 56 are 'Perch-like' fishes occurring all the year round.
55	Family Leognathidae <i>Gerres</i> sp.	X	J.	

List of Fishes of the Kulti Estuary—conold.

No.	Scientific Name of Fish	How Occurring	Stage Recorded	Remarks
56	Family <i>Leiognathidae</i> <i>Leiognathus equulus</i> (Forskål) ..	XX	J., Ad.	
57	Family <i>Sciaenidae</i> <i>Pama pama</i> (Hamilton) ..	XXX	F., J., Ad.	These are the 'Croakers' recorded from fry to juvenile stages in August-September.
58	<i>Pseudosciaena coitor</i> (Hamilton) ..	XX	F., J.	
59	Family <i>Scatophagidae</i> <i>Scatophagus argus</i> (Bloch)	X	F.	
60	Family <i>Nandidae</i> <i>Nandus nandus</i> (Hamilton)	X	J.	
61	Family <i>Trichiuridae</i> <i>Trichiurus savala</i> (Bleeker)	XXX	F., J.	Well-known 'Ribbon' fish, occasionally seen in nets (marine form).
62	Family <i>Stromoteidae</i> <i>Stromoteus sinensis</i> (Day)	X	J.	Marine Pomfrets occurring in 'bheen' nets.
63	Family <i>Anabontidae</i> <i>Anabas testudiens</i> (Bloch)	XX	Ad.	'Climbing Perch', mainly a freshwater form, recorded in the Kulti occasionally.
64	<i>Colisa fasciatus</i> (Bloch) ..	XX	J., Ad.	
65	Family <i>Eleotridae</i> <i>Butis butis</i> (Hamilton) ..	XX	Ad.	Serial Nos. 65 to 73 constitute Gobid fishes and next to <i>Pangasius</i> and <i>Mytus gulis</i> together form sizeable fishery of some meagre value (please see text).
66	<i>Eleotris fusca</i> (Bloch) ..	XX	J., Ad.	
67	Family <i>Gobiidae</i> <i>Apocryptes bato</i> (Hamilton)	XXX	F., J., Ad.	
68	<i>Brachygobius natus</i> (Hamilton) ..	XX	Ad.	
69	<i>Glossogobius giuris</i> (Hamilton) ..	XX	F., J., Ad.	
70	<i>Gobiopterus chuno</i> (Hamilton) ..	XX	Ad.	
71	<i>Odontoblyptus rubicundus</i> (Hamilton) ..	XXX	F., J., Ad.	
72	<i>Pseudapocryptes lanceolatus</i> (Bloch) ..	XX	F., J., Ad.	
73	<i>Stigmatogobius sadanundio</i> (Bennet) ..	X	J.	
74	Family <i>Periophthalmidae</i> <i>Boleophthalmus boddarti</i> (Pallas) ..	X	J., Ad.	Common 'Mud Skipper'.
75	<i>Periophthalmus schlosseri</i> (Pallas) ..	X	J.	
76	Family <i>Platycephalidae</i> <i>Platycephalus insidiator</i> (Linnaeus) ..	XX	J.	
77	Family <i>Cyanoglossidae</i> <i>Cyanoglossus lingua</i> (Hamilton) ..	X	J.	'Flat Fishes'.
78	Family <i>Mastacembelidae</i> <i>Macrognathus aculeata</i> (Bloch) ..	XX	J., Ad.	
79	<i>Mastacembelus armatus</i> (Lacépède) ..	XX	F., J., Ad.	
80	Family <i>Tetrodontidae</i> <i>Tetrodon</i> spp. ..	X	J.	

Nematode worms, small dislodged maggots or dismembered limbs of terrestrial insects, all of which were of sewage origin, were frequently collected. Aquatic insects, like *Notonecta*, *Coryza*, small Dytiscids, *Nepa* and even Crickets, have been observed in plankton hauls several times. All these probably had been washed into the estuary from freshwater channels and suffered no pronounced ill-effects either due to pollution or increased salinity.

Considering Phyto-plankton, various Blue-green Algae were found from time to time. *Anabaena*, *Spirulina*, *Microcystis*, *Oscillatoria* and *Nostoc* were abundant, which indicated a high degree of Polysaprobic condition. These were not only of sewage origin but thrived also in the polluted estuary and were more abundant during low tides. Of the Diatoms, *Coscinodiscus* was the most frequently available genera occurring in each haul but showed a decided decrease in numbers during wet months at lowered salinities. It is probably an indicator Diatom, thriving in polluted estuarine conditions. *Hemidiscus*, a marine form, was recorded on several occasions during high tides. No more than 11 genera of Diatoms were recorded as against 72 species in the Hooghly by Dutta *et al.* (1954). Even under normal conditions the instability of the water and its opacity are inhibiting factors for an abundant production of Diatoms in an estuary compared with clearer fresh or marine waters. In the Kulti, a high degree of pollution further seems to accentuate such unfavourable conditions.

Green Algae were represented by *Closterium*, *Pediastrum* and *Cosmarium* during the rainy season, the Desmids being flushed into the estuary from the adjoining unpolluted streams in monsoon months. A scarcity of Desmids in the estuary otherwise is a clear sign of unrecovered pollutional conditions. A prominent unidentifiable Desmid of marine origin was also recorded several times.

Zygotes of Algae, Zoogaea of *Microcystis*, fungal spores, peltate hair of plants and so on were recorded almost consistently in the Kulti.

It is fairly obvious from the above that the plankton forms are severely restricted within the Kulti to only a few forms as a result of pollution.

Littoral and Burrowing Forms

On the littoral zone, swarms of bright green *Euglena gigantia* were obtained from the greenish scum over the exposed mud flats at low tides close to the outfall. It was interesting to observe the phenomenal spread of green patches of this form when the rich organic mud was being exposed to sunlight.

The marginal zone to a depth of 8-9 feet from high tide mark was beset with numerous burrows of the Fiddler Crab (*Gelasimus* sp.), except between August and October when evidently due to decreased salinity they disappeared from the region. This species seems to be the least influenced by pollution, possibly because it is not subjected to adverse conditions of low tides when it leaves the water and comes to the surface of the mud flats from its burrows and seeks the safety of its burrows during high tides. Burrows of other Crabs, e.g. *Sesarma*, *Dotillopsis*, *Metaplex*, *Tympanomerus* and *Pachygrapsus*, show variations in their density; their number very definitely increasing away from the outfall downwards. They were abundant only below Minakhan, two miles below the outfall, and very rare above. On occasions when there had been an unusually heavy discharge of sewage after a short lull during spring tides, these Crabs were found vacating their burrows and reaching high water margins, gradually crowding upwards with rising tide levels. It is not certain if they died, but a periodic egress from their burrows seems effectively to have contributed to their decline in population within the entire affected zone. Similarly, *Varuna litterata* and *Scylla*

serrata, the two important swimming Crabs, were found dead or dying in low tides. Often they were found on the water's margin, apparently in distress and 'frothing', a very unusual feature, obviously brought on by their vain attempts to breathe atmospheric air. Between May and July once or twice every year, there is usually a high mortality of all the above-mentioned Crabs and other Macrurans as evidenced by the numerous bleached and dismembered limbs and carapaces littered six to seven inches deep in continuous heaps between Haruahot and Malancha along the high tide mark. The receding tides tend to deposit these floating dead animals along the margins. A good number of *Squilla* and even Anomurans could be noticed amongst the shells. This annual extermination of all Crustacean fauna seems to occur on the diversion of the entire sewage into the estuary with the commencement of the rains when the sewage water is no longer required to be fed into the fish farms near Calcutta, Bantola, Dhapa and Hanakhali areas adjoining the sewage channel. Gravid individuals of a few Crabs and Prawns were noticed in the Kulti, but whether they actually can spawn in the estuary is very doubtful.

Another striking feature was an absence of Molluscan fauna along the Kulti margin. During numerous specific searches made in a 15-mile stretch, only dead or floating shells of freshwater Gastropods, e.g. *Pila*, *Vivipara*, *Indoplanorbis*, *Melonoides* and so on, were obtained in the marginal debris. The true saline forms commonly found in the Matlah, such as *Hydrobia*, *Valvata*, *Bithynella*, *Stenothyra* and the common Bivalve, *Cuspidaria*, were totally unrepresented. A few *Teredo* were found embedded in submerged timber. Minute Gastropods were recognized sometimes within the high tide plankton hauls along with some Veliger larvae. Molluscs are very sensitive to pollutional conditions (David, 1957), and their total elimination from the Kulti is not surprising; nevertheless since edible Oysters or Bivalves are rare in Bengal estuaries, an absence of Molluscs is by no means an economical loss.

The burrowing forms of Polychaetes were found along the tidal margin $1\frac{1}{2}$ miles below the outfall. Almost none were seen above the outfall. On one occasion during June, 1948, clustering pink masses of a large species of a free-swimming variety were stranded in the receding ebb tide on the low-lying mud flats below the outfall. These seemed to have become narcotized due to pollutional effects since sewage drain was then in progress. Oligochaetes were unrepresented for nearly a mile downstream as denoted by an absence of casts in the upper region of the intertidal margin.

Associated with the above conditions in the soft mud bathed by the Kulti water were Mole Crickets, Isopods, Beetles and others, all of which were definitely scarcer in the affected zone.

Lack of oxygen alone seems to have little influence on the observed scarcity of the above forms. It is likely that some toxic conditions of water are also partially responsible for the absence of animals which remain bathed in the water for prolonged periods. In considering the associations, it is to be taken into account that stable benthic fauna of the kind noticed in a still-water brackish 'bheri' cannot exist in the estuary proper subjected as it is to violent and turbulent current conditions, tidal and salinity variations.

EFFECTS OF SEWAGE POLLUTION

Fish-life and Fisheries

All estuarine waters within the Bengal delta yield a rich Fish and Prawn harvest and the Kulti estuary was no exception at least till 1939, the first year of sewage admixture. No comparison is, however, possible

since published accounts do not exist regarding the total fishery yield in the Kulti and for that matter from any estuary of the Bengal delta. There is little commercial fishery of any importance at present in the Kulti.

The notable features about the available fishes is that the Mulletts, Perches, Thread-fins, Clupeids (Herrings), Croakers and others with Prawns and Crabs, all of which together constitute the bulk of fishery yield of any Bengal estuary such as the Matlah, are almost entirely absent in the Kulti. Between Haruahot and Minakhan not more than six 'bheen' net units (fixed bag-nets—David, 1953) were operated at any one time between June and October, the more profitable fishing season in a year on the Kulti.

Estimated landed fish on any single day did not exceed 250 lb. for the entire 12 miles stretch by these nets, which were being used mainly for about 18 days in a month during spring tides when chances of capture were better since fish are brought up by the faster flow currents. At the end of 1955 even this fishing was given up by the fishermen of the stretch except for two boats near Minakhan, owing to a further decline in catches. 75-80 per cent of the fish consisted (by weight) of *Pangasius pangasius*, *Mystus gulio* and Gobioid genera, the rest being stray specimens of uneconomical Fish and a few Prawns. In the list of fishes, the species noted at various times by the author are enumerated. The majority of them are recorded from the specimens that would have strayed into the affected zone or washed in by the flow currents.

The only capture fishery that seemingly remains unaffected by pollution and prevalent all the year round is that of the Catfish, *Pangasius pangasius*. Six to eight boats with two to three men in each engage themselves in this capture fishery, netting the river while moving down the ebb and flow currents. The circular cover net, known as 'beshadi', is operated at likely spots. Catches in each boat for 7-8 hours of operation did not at any time exceed 150 lb. (70 kgm.) during June, July and August. In other months only about 20 lb. (9.3 kgm.) were obtainable per boat per day on an average. The specimens were all, however, juveniles ranging in size between 76 and 465 mm., adults having seldom been recorded in the stretch. The cover nets were generally operated near the Kulti outfall where the fish gathered to feed upon the mucilaginous lumps of organic matter brought by sewage. These fish were obviously attracted by the foul smell. Quite often, a good number of *Mystus gulio* were also available in smaller-meshed nets. During very high pollutional conditions even this fishery periodically disappeared.

Stake nets were operated by batches of local fishermen during the spring tide conditions between May and August within the creeks and channels connecting the estuary with the adjoining swamps and other low-lying tracts. At the time *M. gulio* was the predominant fish with a fair percentage of *P. pangasius* in these catches. During the above months, fully mature specimens usually seek entrance to the low-lying freshwater tracts which are flooded by rain water for spawning, which accounts for their large numbers at the time in the river. Between June and July the amount of concentrated sewage let into the Kulti is also less and is appreciably diluted by rain water intermittently.

Cast-net fishermen usually were active in the connecting creeks, catching Eels, *Channa* spp. and small *M. gulio*. Intensity of this method of fishing was never high.

From information gathered it was fairly clear that a rich natural fishery that once existed on the Kulti has disappeared due to pollution. Several species of Sharks and Rays from the sea were also said to be available in pre-pollution days along with other species of Fish and Prawn. The major anadromous fish in the Indian rivers, *Hilsa ilisha*, a Herring, ascends only

estuaries which carry considerable amounts of fresh water into the sea, e.g. the Meghna and to some extent the Hooghly, but the blind estuaries like the Royamangal or Matlah do not attract this form as none drain any 'live' river above.

Nair (1944) has briefly described mortality of fish close to the Kulti outfall and noted that dead specimens were found five miles on each side of the outfall, even during the monsoon when sewage was diluted by rain water. During the present investigations, features as described in Table IV with regard to mortality of fish over one single phase of tidal variations and sewage admixture were noted.

From the observations, which approximate to the prevailing general conditions of tide and drainage with only minor fluctuations in levels and durations of sewage flow, it is seen that even though actual drainage of sewage is for about $4\frac{1}{2}$ hours during a tidal cycle of $11\frac{1}{2}$ hours, a total absence of fish is observed for about 8 hours with an additional period of distress indicated for more than $\frac{1}{2}$ hour. Only for a duration of about 4 hours in the course of nearly 12 hours, or about 8 in 24, can fish survive in the Kulti. But these periods of survival shorten further at the time of fresh inflow of sewage into the Kulti owing to higher tidal levels and larger concentrations of stored sewage. Higher up towards Haruahot the survival period diminishes greatly, and finally within the arterial channels that spill into the culture fisheries around Kharibaria, normally no survival period prevails.

On the impact of sewage, any freshly colonized fish population during the short interval of 'no drainage' period at the height of spring tide is exterminated. *M. gulio*, *Thrissocles* spp., small Mulletts, *Trichogaster* sp. and some *Puntius* have been collected dead in the Kulti. These fish come to the surface swimming feebly and try to keep to the very edge of the water and even attempt to climb the margin of the bank to escape the polluted water. Many overturn, breathing violently, and even gulp air into their stomachs. Such fish in distress soon recover without any apparent permanent injury on transfer to uncontaminated brackish pond water.

No choking of gills by mechanical causes, by organic debris, silt or fungus was responsible for distress and ultimate death of fish. No bacterial infection, fungal or parasitic attack primarily caused any mortality. Dead fish were found asphyxiated as shown by the greatly swollen nature of the gills and distended opercular cavities. Mucus on the gills or on the body did not coagulate, indicating that no sudden chemical change or acidity was responsible for the observed fish kills. Though deoxygenation of the water is a primary cause of death, some septic conditions caused by toxicity due to sulphide, nitrogen compounds (ammonia and other organic acids) and others, released by incomplete bacterial action in the crude sewage, cannot entirely be excluded as causative agents for hastening the mortality. Some of these dissolved gases can be absorbed through the gills by osmosis and can act upon the circulatory or nervous system of fish (David, 1957).

As already mentioned *P. pangasius* alone amongst all the fishes of the Kulti is the most tolerant form. On days when there was no drainage, these fish were found accumulating below the outfall attracted obviously by the odour of small quantities of sewage leaking through the shutters. Being a foul feeder (stomach contents of this fish at Kulti has revealed sewage debris mixed with mucus-like organic substances and fungi thrown into the estuary), this fish seems to have developed a great resistance to foul conditions. In the absence of accessory breathing organs, the fish has developed certain peculiar adaptive characters. The fin membranes and the lips become unusually pink with a rich supply of capillaries, indicating that probably certain amount of compensation for lack of sufficient oxygen

TABLE IV

Drainage Operation Cycle

Condition of Tide	Levels of Sewage Drain or Stoppage	Approximate Duration (Hours)	Observations
Ebb ..	8' 2"—Sewage discharge commenced.	..	Water already charged with sewage moved downwards. <i>No fish life.</i>
Ebb ..	8' 2" to 2' 6"—Sewage discharge continued with increasing velocity and volume.	2½	Sewage concentration increased. <i>No fish life.</i>
Slack ..	2' 6"—Sewage discharge continued.	½	More concentration of sewage below the outfall. <i>No fish life.</i>
Flow ..	2' 6" to 7' 0"—Drainage of sewage stopped at 7' 0" with diminishing intensity.	2	Accumulated sewage below the outfall and freshly draining sewage moved upstream with decreasing sewage concentration. <i>No fish life.</i>
Flow ..	7' 0" to 12' 3"—No sewage drain.	1½	Sewage-mixed water from below moved upwards with a decreasing concentration as the level rose. <i>No fish life.</i>
Flow ..	12' 3" to 12' 9"—No sewage drain.	½*	Equilibrium stage, there being no freshly draining sewage, but the water moving upstream was still diluted with sewage. <i>Fish in distress.</i>
Flow ..	12' 9" to 14' 11"—No sewage drain.	1½	Almost fresh tidal water near the outfall. <i>Fish survived.</i>
Slack ..	14' 11"—No drain ..	½	Almost fresh tidal water near the outfall. <i>Fish survived.</i>
Ebb ..	14' 11" to 12' 0"—No drain.	1½	Almost fresh tidal water near the outfall. <i>Fish survived.</i>
Ebb ..	12' 0" to 11' 0"—No drain.	½*	Appearance of sewage-mixed water moving downstream. <i>Fish in distress.</i>
Ebb ..	11' 6" to 8' 0"—No sewage drain.	1½	More concentrated water moving downstream. <i>No fish life.</i>
Ebb ..	8' 0"—Sewage discharge commenced.	..	Cycle repeated as above.

* This short period of distress is characterized by the noise and clamour made by hundreds of piscivorous birds (inclusive of kites and crows) which move up and down with the tides, following and picking up dying fish within this short moving column of water.

is being met by cutaneous respiration. Under rough experimental conditions, 3 to 5 inches long specimens resisted oxygen depletion of up to 2.3 p.p.m. by coming to the surface of the jars and gulping air which was apparently being stored within the buccal cavity, there being no provision for storing air within the operculum. Two to three bubbles of air were being released every 20–40 seconds, the fish coming to the surface to take in fresh air soon after. At times, the fin membranes also became pink in fish so kept for about half an hour and more. In uncontaminated waters showing 5.6 p.p.m. of dissolved oxygen, this feature was less pronounced. Between 1 and 1.5 p.p.m. of D.O. the fish died like any other species in about 8 minutes. This peculiarity in *Pangasius* of storing air within the buccal cavity and its cutaneous respiration seems to have greatly contributed to its survival in the Kulti.

In the sewage channel itself an occasional *Channa* spp., *Heteropneustes fossilis* or *Clarias batrachus*, all air-breathing forms, were found near the outfall. The semi-aquatic burrowing Gobids show certain interesting features. The common Mud Skipper, *Periophthalmus schlosseri*, which is normally found on all mud flats in every tidal creek and estuary of Bengal, was remarkably conspicuous by its absence. Its non-availability in the Kulti stretch all the year round along the tidal margin can be attributed only to sewage pollution. Since it is semi-aquatic and almost terrestrial in its habitat, its disappearance is definitely not due to any oxygen lack but undefined toxic conditions in the water; the species probably is very sensitive to pollution and has assiduously avoided the stretch. The burrowing *Apocryptes bato* and *Odontoblyptus rubicundus* were found mainly between July and October in 'bheen' nets along with stray *Pseudapocryptes lanceolatus*. These forms were recorded with some dead Prawns and *Mystus gulio* in tidal channels at Kharibaria, having been washed in with flow tides. *Boleophthalmus boddarti* was recorded only twice on the outer muddy banks in October near Minakhan. *Glossogobius giuris*, *Eleotris fusca*, *Ctenogobius nusus* and *Gobiopterus chuno* were variously found under favourable conditions. The semi-aquatic forms of Gobioid fishes seem to be more resistant than all other groups of estuarine fishes to pollutional conditions. These constituted the third item of the meagre fishery yield in the Kulti amongst the economical group.

It has already been pointed out that the numerous Perches, foremost of which is *Lates calcarifer*, the Bhetki; the Mulletts, *Mugil tade*, *M. parsia* and *M. cephalus*; several Sciaenids or Croakers such as *Pama pama* and other related large forms; the 'Indian Salmon', or the Thread-fins, e.g. *Eleutheronema tetradactylum*, *Polynemus paradiseus*; Clupeids, mainly *Thrissoles* spp. and *Setipinna phasa*; the 'Bombay Duck', *Harpodon nehereus*; several Catfishes, *Tachysurus* spp., *Plotosus canius* and others, and a rich variety of Prawns and Crabs which form the bulk of fishery yield from every estuary in the Bengal delta, are almost wholly unrepresented in the polluted Kulti. The above groups as a rule seem to avoid the Kulti stretch as adults, but large-sized *Harpodon* have often been collected dead and putrefying within the 'bheen' nets.

Spiny Eels (*Mastacembelidae*) of which *Macrognathus aculeata* and *Mastacembelus armatus* are common in Bengal, the Mud Eels, *Pisodonophrys boro* and *Amphipnous cuchia*, the True Eels (*Anguilla* spp.), several Murrelets (*Channa* spp.), Silurids, *Heteropneustes fossilis* and *Clarias batrachus* and so on have been observed often in 'bheen' nets and also are dug up from within channels connected with the Kulti below the outfall. The majority of the above species are air-breathing forms or partially so, as described by Ghosh (1934) and Das (1940). But even these inhabited only upper fringes

of the channels subjected to high tide floods rather than the low tide margins which drain concentrated sewage.

Several known freshwater fishes, *Puntius sophore*, *P. conchonius*, *Chela* spp., *Rasbora daniconius*, *Esomus barbatus*, *Oryzias melastigma*, *Ambassis* spp., and even the Climbing Perch (*Anabas testudineus*) have been at times recorded mainly in monsoon months; their presence in saline waters is no more of some academic interest.

All Fishes and Prawns obtained from the Kulti possess an unpleasant odour. The noxious smell persists even when boiled or otherwise cooked in fishes like Mulletts, *Megalops cyprinoides*, Gobioids, *Mystus gulio*, *Pangasius pangasius* and Prawns like *Penaeus semisulcatus* and *Metapenaeus* spp. Consequently even the few fishes caught in the Kulti fetch very little value in the market as compared with Fish and Prawns from cleaner estuaries. The causative agencies responsible for this unpleasant flavour present in the sewage are unknown. The majority of fish spending some time in effluent-ridden waters seem to absorb these odours (David, 1957) readily.

In the Kulti, though populations of fish, majority of which seem to be feeble swimmers that can drift easily in tidal currents, are brought up twice each day, due to continued low levels of oxygen and other still obscure pollutional causes, they are easily destroyed. Large forms except *Pangasius pangasius* seem to avoid the stretch completely.

Availability of Fish 'Seed' and Cultivable Fisheries

In 51 plankton hauls made in the Kulti, at no time free fish eggs have ever been noticed. Larval and post-larval young of Clupeids, Sciaenids, Gobids and some Zoea and Mysis of Crustaceans are, however, recorded during high tides, when the majority of them were found dead. No gravid fish except the tiny *Oryzias melastigma* and *Gobiopterus chuno* (both bearing fertilized eggs) have been actually observed. During the wet months of July-September when salinity decreases, *Mystus gulio* ascends into the freshwater through the Kulti in a fully mature state to spawn as already mentioned. Young of this species of 16-29 mm. have been collected floating dead in large numbers later in October-November months.

High tide floods bring up some young fish to the outfall site under favourable conditions. This is indirectly evidenced by the occurrence of post-larval young and fry of *Thrissocles* spp., *Setipinna phasa*, *Mugil parsia*, *Amphipnous cuchia*, *Periophthalmus schlosseri* and several Prawns and Crabs within brackish pools and pits along the river's outer margin. These pits, from which mud is removed for reinforcing the embankments, are subjected to tidal flooding at least once in a fortnight during the highest high water conditions. After retaining water for the next few days, these pits are washed again by the next flood currents. Sometimes large-sized Prawns and Crabs are also taken from these pits. All these forms, which usually are not seen in the Kulti water, could have been brought up only within the short durations of high tides from the lower reaches.

A limited number of young Bhetki (*Lates calcarifer*) were being brought up under flood conditions between January and March, when connections between certain low-lying tanks along the Kulti are kept open (by cutting) and high water is drawn into them for trapping young *Lates calcarifer* and Prawns. These practices commonly observed first in 1948 had been given up by 1955 because no Bhetki young were reported found in the intervening years.

The previous observations point towards causes for a deterioration of the cultivable fisheries. Ramjoi and Gobadiabad fisheries indicated that

the fishery yield almost wholly consisted of various species of Prawns, mainly *Penaeus semisulcatus* ('bagda chingri'), several *Metapenaeus* spp., *Leander* spp. and a phenomenal number of *Mystus gulio*. Though decline in actual value of the fishery by a lack of Bhetki and Mulletts was reported to be about 75 per cent of the original value, at the time of study the entire income was being derived from Prawns and *Mystus gulio*. Mysis stages of Prawns and adult *M. gulio*, while available in the river during various months, are drawn into the fisheries and allowed to multiply or grow in the sewage-fed water. Sewage-diluted water from the Kulti and entrance of fish are regulated by sluices and a complicated system of gratings, the 'atofs' (Pillay, *op. cit.*). Organic fertilization caused by sewage intensifies and promotes growth of benthic algae, plankton and other food organisms (Basu, 1950).

The cultivable fisheries near Kharibaria, connected as they are with the arterial channels of the Kulti, however, showed almost a total deterioration. A viscid sewage enters these spill fisheries at every high tide for reasons mentioned earlier. Dead Prawns and Fish inclusive of *Mystus gulio* are brought up and even choke the entrances through which water is drawn into the fisheries. Even the hardier Gobioids that were being collected by stake-nets at channel entrances appeared narcotized near Kharibaria. No healthy Fish or young fry or even Prawns can enter the Nowee, Sunthee and the Nonagong to become available for stocking the upper spill fisheries.

In recent years 4-7 inches long *Pangasius pangasius* collected from the Kulti are being stocked in many ponds within Basirhat subdivision. The species is proving successful as a culture fish, with both freshwater and brackish fish in respective ponds or 'bheris'.

REMARKS

Pollutional conditions prevailing on the Kulti are so unlike any known estuarine pollution that it is not easy to draw comparisons; primarily, biotal and chemical conditions offer no scope for setting up conventional zones of pollution, septicity or recovery as in the case of freshwater rivers flowing steadily in a single direction. There is also a constant shift in the substratum, which is not conducive to a deposition of silt or sludge and encourages a stable benthic population peculiar to polluted waters. No organic detritus can settle and decompose in the Kulti river bed.

In understanding the brackish-water ecology and fauna in the estuaries of India, the contributions made by Annandale (1907, 1915a and 1915b), Chaudhuri (1922), Hora (1922), Kemp (1917), Pearse (1932), Sewell (1934), Panikkar and Aiyar (1937) and Pillay (*op. cit.*), among others, are most useful. Panikkar and Aiyar (*op. cit.*) have briefly summarised the rigorous conditions of existence facing brackish-water animals which therefore have to make an aggressive attempt to survive. This results in their prolific breeding, curtailment of stages in life history, adaptations to changing salinity conditions by osmotic regulations, possession of integumental structures for aerial respiration, secretion of profuse mucus to prevent desiccation and so on. Majority of the above features are exhibited by the fishes and other organisms of the Kulti in various degrees. In spite of so varied a modification, it is noticed that sewage pollution has thoroughly affected the population mainly by a continued oxygen lack (though not a complete absence) and perhaps by undesirable toxic substances originally present in or released by septic sewage in the process of disintegration. The effects of a heavy load of organic pollution aggravates the situation further. It has been shown that the concentration of sewage

is too high to enable most organisms to survive as there is very slow dissipation normally. Observations made by Alexander *et al.* (1935) are on too mild an estuary compared with the Kulti.

As already mentioned, periodic kills of Fish and their fry, or of Crustaceans and their various early stages brought up in swarms by currents, do take place in the Kulti, contributing to a large amount of loss all round. Fortunately the Kulti, with its surrounding fisheries, forms more or less a closed bio-hydrographic system where a heavy load of sewage is confined. Recovery is restricted mainly due to a lack of fresh supply of diluent waters above. Since the sewage can get dissipated quickly only 5 miles below the outfall, the lower estuaries receive such dilutions. But the high tide waters show that the effect is also severe below and the plankton life is much too scarce compared with unpolluted estuarine waters elsewhere.

Sedimentation of organic detritus or sludge being impossible, no polysaprobic organisms are found at the bottom as is normally observed under septic conditions in freshwater rivers. The indicator organisms and sewage-resistant forms are therefore to be found amongst the plankton. Even here, the constant agitation and continuous sewage replenishment has greatly impeded photo-synthetic activity. Phyto-plankton species number about 22, Diatoms being the dominant group besides the Blue-green Algae which is mainly of sewage origin. Considering organic fertilization, phyto-plankton organisms are very poorly represented.

Since the estuary is situated in a sparsely populated area, nuisance value is less. No hindrance to navigation, such as it is, by country boats is caused by accumulation of sludge. Any epidemics due entirely to sewage in the belt also are unknown. Kulti water, or for that matter any estuarine waters, are seldom if ever used for bathing or washing in Bengal. So long as the Kulti remains in its present active form the city of Calcutta need no more worry about its sewage disposal, and being the best medium for carrying away the sewage, fishery importance of the creek and its fisheries assume only a secondary role as compared to the health of the great city.

Certain amount of relief is provided for a loss of the fishery value by *Pangasius pangasius* and *Mystus gulio* whose yield does not seem to have deteriorated. If properly managed, the brackish-water culture can probably be improved as fertilizing action of sewage on the food of available species has been one of enrichment (Prawns and *M. gulio*). Natural stocking of 'bheris' and spill-water fisheries, however, have been affected by excessive pollution. It is also noted that the Kulti or any of the blind estuaries of Bengal which do not have abundant fresh water in the monsoon season do not attract the *Hilsa* from the sea, which migrates hundreds of miles otherwise in the Ganga. Kulti therefore is not a highway for any economical migratory fish between the sea and the freshwater rivers.

The following remedial measures can be suggested, considering that the Kulti offers the easiest means of disposal of Calcutta sewage, and the ill-effects on the fisheries is of less importance than usefulness of easy disposal of wastes from the city :

(i) Completion of the dry-weather and the storm-water channels as originally planned.

(ii) More effective and quicker treatment of sewage and its sedimentation to avoid toxicity developing in the sullage and quicker transport of such sullage to the outfall head.

(iii) At present there does not seem to be a complete bacteriological dissociation of organic matter (contrary to claims made by authorities

of Calcutta Corporation). The inhibiting substances should be discovered and eliminated.

(iv) Sewage has to be diluted still more as in its present form it is a very viscid liquor at an incomplete stage of disintegration.

(v) The outfall vents should be opened only at ebb tides so that flow tide drift of sewage to Haruahot can be avoided, if not altogether stopped. This entails a little more vigilance at the outfall site; but the procedure will serve the interest of the fisheries above the outfall as some young Fish and Prawns can then plant themselves in these brackish-water fish farms.

SUMMARY

While determining the effects of sewage from the city of Calcutta upon the fish-life of the Kulti estuarine creek, certain hydrographical, chemical and biological investigations were undertaken. The mode of sewage admixture and the impact of the forceful tidal effects upon dissipation of the sewage load show that the accumulated sewage mainly oscillates in the region without dissipating quickly, and has converted a length of about 30 miles of the creek into a vast septic tank.

The chemical tests of the water have shown a subnormal dissolved oxygen content under all conditions together with other unfavourable factors. At high tides, apparently when the estuary is to be free from contamination, chemical tests still reveal that the condition of the water was quite unsatisfactory to support a normal fish community. The plankton and other biotal organisms are very poorly represented when compared to the adjoining uncontaminated estuaries.

Fish-life is almost totally eliminated by the gross pollutional load and can only exist within the Kulti for about eight hours during the course of two tidal cycles in a day. The obvious ill-effects are mainly due to asphyxiation caused by deoxygenated water. Undetermined toxicants brought from industrial plants as well as those generated by an incomplete bacterial action appear to add to the totality of unfavourable conditions of existence both for Fish and other organisms.

Fishing as an industry is non-existent. Eighty species recorded are mainly brought up by the force of flow currents. The *Pangasius* Catfish, however, seems to be unaffected, having developed certain breathing traits to compensate an oxygen deficiency in its environs.

Fish larvae and Prawn young, which are used as 'seed' for planting brackish-water culture fisheries, have almost entirely disappeared, the numerous 'bheris', particularly within the spills of the Kulti's upper arterial channels, suffering thus a great loss.

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The author expresses his thanks to Dr. A. N. Banerjee, the Outfall Engineer, and Sri Bhupathi Banerjee for information regarding sewage disposal and accommodation at Kulti. Dr. N. K. Bose, Director, River Research Institute, West Bengal, furnished part of the information on the hydrology of the Kulti from his administrative reports. Dr. T. J. Job, the former Chief Research Officer, and Dr. B. S. Bhimachar, the present Director of this Research Station, started the author on these investigations and encouraged him to bring the findings in the present form, and the author gratefully acknowledges their help. Sri B. B. Bose kindly analysed water samples, for which the author is indebted to him. Dr. M. P. Motwani suggested some improvements in the manuscript of this paper for publication.

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REVIEWS OF BOOKS

STUDIES IN THE UPANIṢADS. By Govindagopal Mukhopadhyaya, M.A., D.Phil., Sāṅkhyatīrtha, Assistant Professor of Sanskrit, Sanskrit College, Calcutta. Calcutta Sanskrit College Research Series, No. IX, 9½ × 6, pp. i-xvii + 1-308. 1960.

The book lacks perspective. For a profitable study of the Upaniṣads, it is necessary to understand their background in the Mantras, Brāhmaṇas and Āraṇyakas and a comprehension of contemporary systems of philosophy, especially Buddhism and Jainism. This approach was emphasized by Max Müller in his Introduction to his translation of the Upaniṣads, Sacred Books of the East Series, 1884/1900, p. lii, as follows :

‘In doctrine the highest goal of the Vedānta, the knowledge of the true Self, is no more than the Buddhist Samyaksambodhi; in practice the Sannyāsin is the Bhikṣu, the friar, only emancipated alike from the tedious discipline of the Brāhmaṇic householder, and the yoke of useless penances imposed on the Brāhmaṇic dweller in the forest. The spiritual freedom of the Sannyāsin becomes in Buddhism the common property of the Saṅgha, the Fraternity, and that Fraternity is open alike to the young and the old, to the Brāhmaṇ and the Śūdra, to the rich and the poor, to the wise and the foolish. In fact, there is no break between the India of the Veda and the India of the Tripiṭaka, but there is an historical continuity between the two, and the connecting link between extremes that seem widely separated must be sought in the Upaniṣads.’

Mahāmahopādhyāya Dr. Gopinath Kaviraj in his Foreword (pp. xxiv-xxv) stresses this necessity when he advises the author that ‘valuable light might be thrown on this study, with special reference to several obscure issues involved, if it included within its scope a careful consideration of the contemporary religious thought-currents outside the Upaniṣadic pale in the esoteric circles of Buddhism and Jainism * * *’.

The book under review appears to treat much of the Upaniṣadic lore as almost *sui generis*; its pseudo-mystic bias has produced a strange interpretation of the Viṣṇu hymn (*RV.*, 1.154.5), p. 297. A study of the Upaniṣads must not ignore Max Müller and Kaviraj.

Under Parts I-III, Goal, Way and Attainment, the book deals with the problems of Reality and Knowledge; Preparation, Contemplation, the Synthetic Way, the Analytic Way; the Attainment. The description of the contents of the important Upaniṣads is adequate. The immaturity of their evaluation is reflected in the intemperance of expression : ‘That the real significance has been missed is evident from the lamentable confusions and deliberate distortions made about this sacred teaching by almost all of the Western scholars and philosophers even up to the present day’; worse language follows—‘their (Western scholars’) total lack of apprehension of the transcendental nature of the Upaniṣadic knowledge’ (p. 1). Ranade in his *Constructive Survey of Upaniṣadic Philosophy*, 1926, p. 5, has dealt with this aspect more intelligently : ‘* * * all the great commentators, Śaṅkara, Rāmānuja and Mādhva, have made the Brahma-sūtras the pivot for their philosophical speculations, and the Brahma-sūtras were an aphoristic summary of the doctrines of the Upaniṣads.’ Indeed the Vedānta Philosophy stands to the Upaniṣads almost in the same relation in which the Philosophy of the Schoolmen stood to Aristotle. The theological

disquisitions of these commentators resemble what Bacon said about the arguments of the Schoolmen, borrowing the idea from Ariston, that they 'resemble more or less a spider's web, admirable for the ingenuity of their structure, but of little substance and profit': it must be borne in mind that there is a fundamental difference in the methodologies of the Upaniṣads and the Vedānta. The subjective approach in the book under review has not always followed this difference.

There are certain minor blemishes in incorrect translations, e.g. p. 135: 'non-contradictedness and novelty' for *abādhitatva* and *anadhigatatva*: *anadhigatatva* cannot in this context be translated as *novelty*.

The *Studies* are a commendable endeavour by a promising scholar who may attain fulfilment in the fullness of time.

A. P. BANERJI-SASTRI

AYURVEDIC TREATMENT OF CANCER. By Dr. Prabhakar Chatterjee.

This book has been written with a view to elucidating the etiology, diagnosis and treatment of cancer from the Ayurvedic point of view. The author admits in Chapter V, page 31, that 'in the ancient texts on Ayurveda no mention is found of a disease answering to the modern nomenclature of cancer or "Karkata"'. The author believes that the disease designated as 'Rohini' in Ayurveda has an exact resemblance to throat cancer. According to the author, the Ayurvedic denomination of cancer is 'Visarpita Raktārvuda', but no references from the recognized books on Ayurveda have been given to substantiate these points.

Regarding the etiology of cancer, the aggravated Vayu, Pitta and Kapha either severally or conjointly have been instrumental in producing fleshy nodules which, when aggravated and overgrown, put an end to the patient's life. It is difficult to accept this theory without proper and rational demonstration.

The author has tried to diagnose cancer in various parts of the body by dividing it into different stages. Evidently these stages have been conceived by the author or the idea borrowed (though very incompletely) from the modern textbooks of medicine. Apart from clinical manifestations, the most fundamental point in diagnosing cancer is laboratory studies by biopsies. This point has not been touched by the author, although many modern things like radium, X-ray, etc., have been referred to. The treatment portion is most disappointing. The lines of treatment suggested are incomplete and mostly inconclusive. According to the author, 'the earlier authorities on Ayurveda headed by Charaka, Sushruta, Vagbhata and others, while dealing with the various types of cancer appearing in the different parts of the human body, have declared them as incurable...' (Chapter VIII, page 65). 'In the later Tantric age, however, authorities on mineral therapeutics, such as Adima, Chandrasena, Manthana, Nagarjuna, etc., had attained a pre-eminent degree of success with mineral medicines in the treatment of many diseases declared as incurable by Charaka and Sushruta, etc.' The author further says, 'It is not to be understood, however, that the drugs invented by the earlier physicians like Charaka are quite ineffective in the treatment of cancer, but that amazing results are obtained by mineral therapy in combination with those drugs' (page 66). The above statements made by the author are rather confusing. How can the amazing results be obtained in a disease which was not clearly defined in the Ayurveda? Even taking for granted that the cancer disease was detected during those days, how can the amazing results be obtained

when the pioneers of the Ayurveda, viz. Charaka, Sushruta, etc., have declared them as incurable and have given no systematic course of treatment?

We are all in search of the problems dealing with cancer in the Ayurvedic literature. It would have been a meritorious work had the author attempted to compile all the relevant facts and figures on the etiology, diagnosis and treatment of cancer from the ancient Ayurvedic literature, giving the exact references and quotations. Medical science is a progressive and experimental science and the tendency of the research workers on medical science is not to ignore the valuable contributions of ancient medical literature, but to incorporate the scientific part of it into the advanced knowledge of medical science.

SUBODH MITRA

SANGEETA-DAMODARAH OF SHUBHANKARA. Edited by Gaurinath Sastri, M.A., D.Litt., and Govindagopal Mukhopadhyaya, M.A., D.Phil., Sankhyatirtha, Sanskrit College, Calcutta. Price Rs.15 only.

We are glad that this much-talked-of but little-known Sanskrit treatise on Indian music and dramaturgy has at long last been published by the Research Department of the Sanskrit College, Calcutta. Publications like *Shabda-Kalpa-Drum* or *Bhakti Ratnākar* and *Sangeeta-Sāra-Saṃgraha* of Narahari Chakravarti (Ghanashyam) copiously quoted from this book, but during the last fifty years all attempts to trace a complete and correct copy of this valuable work have been unsuccessful.

As it appears from the treatise, its author was a devout Vaishnava. But nowhere in his treatment of dramaturgy he quotes from Rupa Goswami's *Ujvalanilamani*, a work of the sixteenth century. This shows that he preceded Rupa Goswami and supports the surmise of the editors that Shubhankara flourished in the fifteenth century. In all probability, he belonged to North Bengal, as maintained by the late Professor D. C. Bhattacharya.

Sangeeta-Damodarah is more or less complete as far as dramaturgy is concerned, but in dealing with matters of music it is far from being complete or even satisfactory. There are many important chapters in the study of music which have been completely ignored in this book, and in some other matters the author avoided an elaboration that would have helped to clarify them.

But such facts do not detract from the importance of the work. Treatises like *Sangeeta-Damodarah* and *Sangeeta-Nārāyaṇa* are important exceptions to the general claim that all Sanskrit treatises on Indian music were written in Southern or Western India. The author was responsible for another book on dramaturgy entitled *Hasta-muktavali* supposed to be found in Nepal. This book was noticed a few years ago in the *Journal* of the Madras Music Academy.

About the origin of Rāgas the author does not follow the beaten tract of ascribing them to 'Śiva', but to the Gopis singing to Sri Krishna inspired by his playing on the flute. Although Shubhankara mentions six Rāgas and their consorts like so many other authors, the above theory widens the scope in the number of Rāgas and supports the old view that there is no end of Rāgas and Tālas, or they are at least as numerous as the number of Gopis which is traditionally known as sixteen thousand.

The work gives a very interesting account of Tālas of Indian music. It may be remarked that, while the Tālas used in the classical music of today are scarcely mentioned or described in Sanskrit books on music,

many of the Tālas mentioned in *Sangeeta-Damodarah* are still used in the Keertan of Bengal both in name and form.

This publication will certainly help to open up new avenues of research and reveal some unknown facts in the study of Indian music.

SURESH CH. CHAKRAVARTI

BUDDHA AND BUDDHISM. By Dr. R. G. Basak. Sambodhi Publications, 130 pages.

This brochure is a collection of seven lectures delivered by Dr. Basak from time to time at the Ramakrishna Institute of Culture, Calcutta. In the first lecture the author deals with the basic teachings of early Buddhism from Pali sources but he interprets *Nirvāṇa* in the developed Mahāyānic form. He opens the second lecture with a short biography of Aśvaghōṣa and then gives a running account of Buddha's life as it appears in the *Buddha-carita*, chapter by chapter, and concludes the lecture by tracing Mahāyānic influences in Aśvaghōṣa's writings. The third lecture contains the episode of the fight of Buddha with Māra (interpreted by the author as 'the mental foe') on the eve of his enlightenment as related in the *Mahāvastu*. It is concluded with the *Divyāvadāna* story of the conversion of Māra by Upagupta, the spiritual guide of Aśoka. In the next two lectures the author presents from the *Mahāvastu* the account of the conversions of Śāriputra and Maudgalyāyana as also of Rāhula and ends the fifth lecture with his observations on the changes effected by the Mahāsaṅghikas, leading to Mahāyānism. He mentions that the conception of Pratyekabuddha appeared for the first time in the *Mahāvastu* but, in fact, in the very old Pali text, *Sūttanipāta*, there is a whole poem devoted to the Pratyekabuddhas. The sixth lecture deals with the story of Aśoka's charity and devotion to Buddhism as given in the *Divyāvadāna* (*Aśokāvadāna*). In the last lecture, the author discusses the ethical and philosophical teachings common to Buddhism and Brahmanism and points out the extent to which the former was allied to the Sāṅkhya and Yoga systems. Dr. Basak confined himself to the few Buddhist-Sanskrit texts mentioned above, and so his lectures represent a developed form of Buddhism. The presentation is lucid and interesting, and at the same time learned and critical. The book offers a pleasant reading and is an excellent handbook for general readers interested in Buddha and Buddhism.

N. DUTT

HISTORY OF JAINA MONACHISM. By S. B. Deo, M.A., Ph.D., Poona, ix + 655 pages.

It is a learned and at the same time a voluminous work on the history of Jaina monachism in six parts. The first part is more or less an introductory one, dealing with Indian monachism in general. The second part is devoted to the expansion of Jainism up to the Moslem period and is based mostly on epigraphic materials. It is a masterly survey of the career of Jainism all over India during the twenty-two centuries of its existence from its inception. The third part deals with the Jaina literature, both Canonical and post-Canonical. The fourth and fifth parts offer a neat and exhaustive account of the Jaina monastic rules and religious practices. The last part contains the author's observations and a gist of the Jaina jurisprudence. It is replete with an Index and a Glossary. Throughout the work the author maintains balance of his judgment and presents his

materials in the true spirit of an historian. It is the first book of its kind, dealing minutely with all matters associated with Jaina monachism. The author marshals his vast materials with a commendable brevity and perspicuity. It is a valuable contribution to the study of Jainism.

N. DUTT

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¹ With an English-Tibetan Vocabulary.

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